This deals with the answers
+ issues of the giant decrease
in cost estimates. of Phase I.

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MEMO FOR Directors / RM

Attached for your information is a copy of the transcript from General Monahan's hearing before the HASC R&D Subcommittee.

Jeanine Ellars
Jeanine Ellars
Legislative Affairs

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# Committee Hearings

**of the**

# U.S. HOUSE OF REPRESENTATIVES

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STRATEGIC DEFENSE INITIATIVE

ORGANIZATION RDT&E BUDGET REQUEST

FOR FISCAL YEAR 1990

Tuesday, March 14, 1989

House of Representatives,

Subcommittee on Research and

Development,

Committee on Armed Services,

Washington, D.C.

The subcommittee met, pursuant to call, at 10:05 a.m., in Room 2337, Rayburn House Office Building, Hon. Ronald V. Dellums, [chairman of the subcommittee] presiding.

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Mr. DELLUMS. The Subcommittee on Research and Development will come to order.

This morning, the Research and Development Subcommittee will take testimony on the Strategic Defense Initiative program. Our witness will be Lieutenant General George L. Monahan, Jr., Director of the Strategic Defense Initiative Organization.

General Monahan was confirmed to this position last fall and officially became the Director in February, with the retirement of General Abrahamson.

The Reagan budget request for the research and development portion of SDI is about $5.6 billion, representing almost a $2 billion increase over the authorized level of $3.6 billion in fiscal year 1989. Between fiscal year 1985 and fiscal year 1989, the administration has requested about 5.5 billion more than the Congress has appropriated for the Strategic Defense Initiative. Each year, 1985 through 1989, the Congress has reduced the request somewhere between 20- and 30 percent.

General Monahan, I would think that given this past history and the extreme pressures on the budget this year, that chances of achieving this $5.6 billion level for the SDI program are extremely remote. Based on history, a level closer to 3.5- to $4 billion would represent a more realistic estimate of the outcome, although I personally

believe that it should go even lower and focus solely on basic research.

It would seem to the Chair that there must be, from even the most ardent supporter of the efficacy of this program, concern with respect to the administration's ability to efficiently run a program that must be adjusted 20- to 30 percent downward each year over the requested level. I would think that this would be an extremely inefficient operation.

I know of no other defense program where the Congress has consistently reduced a program and the administration has continued to come in with over-optimistic funding requests six or seven years in a row. I would hope that this new administration could define a more clear set of objectives for the SDI program and seek approval of these objectives from Congress and debate on the merits or the lack thereof so that a more stable funding profile can be established in the out-years.

General Monahan, I appreciate the fact that you are just now taking over this job and we do not have a confirmed Secretary of Defense, but I would ask that you articulate as best you can the objectives of the program and provide any insights that you might have on the options that you are looking at as President Bush works through his reduced military budget.

Before you begin, I would like to recognize my distinguished colleague, the gentleman from Alabama, Mr. Dickinson, for such time as he may consume for any comments he deems appropriate at this time.

Mr. DICKINSON. Thank you, Mr. Chairman, and thank you, General Monahan, for your appearance here today. We welcome you to your initial congressional appearance in your new role as Director of SDIO.

It is my understanding that you are here today to discuss SDI's current status, as well as President Reagan's 5.6 billion, which should make for a lively discussion. We all understand the difficulty inherent in your current position due to the leadership vacuum in the Pentagon and the general lack of policy direction from the Executive Branch at this point.

I gather that you do not intend to venture into the realm of the SDI policy today, but such a decision is wise and--I think such a decision would be wise for all program managers. It is more important that a program manager view his or her role, in my opinion, to answer the technical questions such as can we, rather than should we. It would be useful for the subcommittee if you would discuss briefly what you perceive your role to be and providing your views up front will hopefully allow the subcommittee to pursue appropriate issues and to avoid turning this hearing into a

protracted and inconclusive policy debate.

To the extent you are able, the subcommittee would also be interested in hearing about any policy guidance that you might have received to date from the new administration, the Bush Administration. As my chairman alluded to, the Reagan budget, we feel, is not practical.

We have seen this so successfully and we have seen the Congress year after year scale it back to what we felt--even though we are supporters of the program in general--we felt was a more doable and practical funding level.

Finally, let me express one broad concern I have on this year's program. Last fall, a lot of political blood was shed in the battle to prevent certain factions in Congress from micromanaging the 4.1 billion that it authorized. One of the primary reasons that I urged the president to veto the defense budget was due to the fact that after we had dramatically reduced the funding for the SDI program, then some in the Congress wanted to go in and fence and micromanage the balance, or a big portion of the balance, absolutely denying the flexibility to the Director of going forward with the most promising programs and being able to delete those programs that didn't show as much promise.

There was a lot of debate and a lot of concern over this. As a result of the veto, we were able to do away with most of the fencing. As a matter of fact, as it turned out, I

think the president came out looking pretty good in the whole detail matter.

The centerpiece of the battle was the SBI, space-based interceptor program, a program that certain members wanted to cut by 25 percent and, as I said, micromanage the rest. As part of the post-veto compromise, however, Secretary Carlucci explicitly reassured Congress that no individual SDI program would receive a budget reduction that was disproportionate to the approximately 18 percent funding cut that the overall program took. In our conference with the Senate, Chairman Aspin and myself, Nunn and Warner, meeting with Carlucci, wrestling with this problem--I think we had two or three meetings on it--this is what we were told.

Despite the guarantee, though, the 1989 space-based interceptor program was down-scoped dramatically. At some point in the discussion here today, I would appreciate it if you could explain how and why the SBI program was reduced, and if you agree with that or if some effort will be made on your part to remedy what was done.

We have a lot of ground to cover today, so I will take no more time. I look forward to your testimony, General, and again I would like to wish you well in your new endeavor and welcome you here. I am sure we will be seeing a lot of you in the weeks and days to come.

Thank you, Mr. Chairman.

Mr. DELLUMS. Thank you. The gentleman yields back his time, and General Monahan, without objection, the full text of your testimony will appear at the appropriate point in the record and you may proceed in any fashion that you choose.

STATEMENT OF LIEUTENANT GENERAL GEORGE L. MONAHAN, DIRECTOR, STRATEGIC DEFENSE INITIATIVE ORGANIZATION

General MONAHAN. Thank you very much, Mr. Chairman. As you just mentioned, I do have a statement to submit for the record ~~and~~ that I propose ~~that~~ I submit. ~~that.~~ But, ~~I would like~~ ~~today,~~ first of all, in doing a presentation, I am going to bring up the questions you just raised, so that we will get to those, and I will make sure that we save time because those are very important questions that both of you just added on.

~~What I would like to do, however--~~As you know, we have a strategic review under way in the Executive Branch at the present time. That Executive review is looking at all of our strategic programs, including the Strategic Defense Initiative, and because of that, the program that is in the president's budget at the present time is probably going to be changed, and it may be changed substantially. I don't really know how much and I don't know if our objectives will be changed a lot. ~~but nevertheless,~~ Nevertheless, I expect that when the strategic review is completed and when a revised president's budget is submitted, should one be coming, ~~should be submitted,~~ that the Strategic Defense Initiative will be impacted, just as will many, many other programs.

I think it is very useful that we understand that the

program does, indeed, have a baseline that was approved by the Defense Acquisition Board last fall. That is the program that is in the current president's budget. I propose that I take you through some of that so that you can understand that program, because ~~it is from there that~~ various options for proceeding in the future will logically be derived from there.

That is why I have a handout that I believe all of you should have ~~up there~~ and I would like to proceed and go through that particular handout with you and just bring out some of the high points that are involved.

On the second page, there is a listing of the SDIO objectives. They have not changed, in the broad sense, over a period of a few years. You should note that it says to conduct a vigorous research program, to develop the key technologies against the ballistic missiles, and look at options for deployment and to carry out a program in consultation with our allies. I think working the program with our allies is a major aspect of it that is very important.

On the third page, the current program structure is based on the original SDI charter and it is worked against a requirement from the Joint Chiefs of Staff. So ~~it does, at the present time--~~the program that is in the president's budget at the present time is backed up by a JCS requirement. The Defense Acquisition Board met in October ~~of~~ 1988 and ~~had the~~

~~program~~ approved the program proceeding into a demonstration/validation phase for most of the elements that are in the first phase.

We go to the next page, number 4. This describes the program that is in the president's budget and was approved by the DAB. You will note that on the right-hand side that it is divided into two phases, a phase 1 and a phase 2. I am going to concentrate mostly on phase 1 today.

Phase 1 is further divided into three major elements: the sensors, the command and control and the initial interceptors. Those will be kinetic kill type interceptors.

Note that the sensors would come first in the development and, indeed, we are in the demonstration/validation phase of the sensors at this time and one of the sensors, the boost surveillance and tracking system, could enter full-scale development as early as next year.

The command and control system comes a little bit after that and finally the interceptors. Advanced weapons, then, come in phase 2.

If we go to page 5, this just kind of encapsulates what I said. Note that in the first phase of the program, it is kind of a large green area there and that depicts a couple of things. Number one, and in the first phase of the program we will be building the basic infrastructure upon which the subsequent phases would be built.

Secondly, the first phase of the program, you will note, says kinetic energy interceptors. So the first phase would concentrate on those. Those are interceptors that destroy ballistic missiles or reentry vehicles simply by collision. No explosive charge or munition of any sort.

We get into subsequent phases, phase 2 and phase 3, then we get into the directed-energy weapons, such as lasers, either ground-based or space-based or neutral particle beam weapons.

On page 6 is, ~~first of all~~, ~~a history of~~ as the chairman pointed out ~~— the~~ a history of the funding versus the president's budget request in the past. I just want to make one point here. If I take the 3.7 billion that was appropriated for fiscal year 1989, then in order to pursue the program that I am going to describe to you, which, as I said, will probably be altered in the strategic review, then the funding there, 5.6 in 1990 and 6.7 in 1991 would be required to pursue this particular program.

Go to page 7. I would begin to describe the phase 1 system and the job that it is to do. First of all, go from right to left on the chart. It is useful to describe the path that a ballistic missile takes in the various phases of its flight. First is the boost phase. I think that is self-explanatory.

Then in the post-boost phase, the boosters have dropped

away from the missile and the reentry vehicles that are on what we call the bus, on the top of the missile, then start to deploy. When you get to the mid-course phase, then all the reentry vehicles and any decoys are flying on their own. They are now deployed from the bus and finally, when you get into the terminal phase, they are reentering the atmosphere.

As I describe the program, I am going to first ~~of all~~ describe sensor elements ~~and the sensor elements~~--we will again start from right to left on the chart.-- ~~I will describe the sensors~~ that look for the initial boost phase and then sensors that finally look to the terminal phase. Then I will talk about interceptors, space-based interceptors, which would have the objective of intercepting boosters in the booster/post-boost phase and finally reentry vehicles by ground-based interceptors in the mid-course phase or terminal.

The next page--and I have just made a separate sheet to hand out because we can get wrapped in alphabet soup in this program very quickly. This is just--and you might just want to keep that handy, because it describes what these abbreviations are for that I will be--what the abbreviations mean, the abbreviations I will be using throughout the presentation.

The first sensor, if I go to page 9, is what we call the

BSTS, the boost surveillance and tracking system. Its job is to look at the entire globe from a very, very high orbit, geosynchronous orbit, and it does, in that sense, the same thing that current satellites do today, and it can detect, among other things, ballistic missile launches. ~~You can se~~ It could detect ICBMs, IRBMs, SLBMs. It will acquire missiles that have been launched, start to track them, determine what type they are and try to give us an assessment of whether or not we are able to destroy them, and then it plays a big role in communications and battle management.

On the next page, 10, you will see an artist's conception of two of the concepts that are possible for BSTS. We have two contractors at the present time and they are in a demonstration/validation phase with these two types of satellites, but it is also possible for other contractors, when we go into full-scale development, to enter the competition, should they have other satellites that would meet our requirements.

The 11th page, then, is a depiction of the coverage that a BSTS has, and I tried to draw this particular chart to scale as far as the earth and where the orbit is with the geosynchronous orbit 22,000 miles above the earth, and note that we would envision a system of probably six satellites. That gives us good overlapping coverage of all areas of the

earth at all times.

So that is the first sensor and that is the sensor that would detect the initial launch of a ballistic missile, from wherever it occurred on the earth.

The next sensor is the space surveillance and tracking system. Besides being able to track ballistic missile boosters, it also has the capability to track reentry vehicles or at least clusters of reentry vehicles and the post-boost vehicle. The post-boost vehicle is the vehicle on which the reentry vehicles are mounted and it is from the post-boost vehicle that they are deployed.

It would act as a fire-control sensor for space-based interceptors. It would be able to at least see clusters of reentry vehicles and decoys and could hand those off to the ground surveillance systems and the ground-based radar.

On page 13 is an artist's conception of what a space surveillance and tracking system (SSTS) satellite would look like.

Page 14 is, I think, a little bit more interesting because it shows the ~~it shows~~ the coverage of these SS~~D~~TS. Note, they have kind of a donut shape coverage and because they don't have to look at the earth--and we very purposely do not have them staring at the earth, but rather out into space, that way they don't have to worry about the clutter that comes from the earth background and are able to see much,

much smaller objects than that boost surveillance and tracking system was able to.

Then the third sensor in the system, as we now get down to finer and finer grain of tracking, is the ground-based surveillance and tracking system (GSTS), which is there to discriminate reentry vehicles from decoys or other penetration aids. It also is a backup to the SSTS should the SSTS be attrited or somehow or another compromised and also the capability to track objects at lower altitudes.

An artist's depiction on page number 16, and the one thing that may or not be evident from this, but this is a suborbital device; i.e., it does not go into orbit. It is launched from the ground as we get a warning from the BSTS or the SSTS that there is a raid incoming and it is launched.

Now, on the next page, number 17, you will see the potential coverage where those may be launched from, but it has a lifetime of maybe 15 or 17 minutes, something of that sort, but in that period of time, is able to discriminate between reentry vehicles and possible decoys and pass that information down through the command and control system.

Finally, the most fine-grained element of the system, on page number 18 is a ground-based radar. ~~and here --~~ This is the first time that radar comes into play among these sensors. The previous sensors I described all were infrared type

sensors. Now we are using a radar so that the characteristic radar of being able to do some very fine-grained observation for us can now come into play.

Here is an artist's conception on page 19 of either perhaps a mobile version of a ground-based radar or one that is stationary. There are various concepts we have under consideration at the time. This is one of the sensor elements that has not yet entered into the demonstration/validation phase, but it will very, very shortly. The other elements I just described were all in the demonstration/validation phase.

Finally, those are the sensors now that I have described. I described them from ~~the most--~~those that take the broadest ~~grossest~~ look, able to just detect boosters, to those that can detect and discriminate reentry vehicles. To tie it all together, we need a command and control system. On page number 20, I begin to talk about that.

Note the first bullet on there. Through any scheme that I have ever heard of for the Strategic Defense Initiative, man is in control. Man is in the loop in controlling these various elements of the system, so the decision authority rests there. There is no such thing as an automatic initiate or anything of that sort.

We would plan--and our thinking is not all that well defined at the present time--but we would plan on fixed

command centers within. For reasons of survivability, I think we clearly have to have mobile command centers also. The command and control system for SDI promises to be very complex. I don't see anything that is really undoable about it. It will be a complex system to engineer.

On the next page, 21, is a picture of what we call EV-88, an early version. That is a picture from down at Huntsville, Alabama, where the Army's Advanced Research Center has been doing some advanced simulation work for us and are fairly well along on coming up with concepts that will work well in the command and control.

So, now, getting to page 22, I have described the sensors; I have described the command and control system; now let's look at the interceptors themselves, the kill vehicles themselves.

By the way, what I just showed you in the way of the sensors~~--those~~ may or may not be treaty-compliant. In other words, what I have just described, in a command and control system, there is still--some of those have the possibility of
treaty compliant)
~~because~~ For example, the GSTS has a role that is ~~very--that is~~ not only SDI, but also has the role of replacing the DSP satellites we have today, and a space surveillance and tracking system also has the role of looking for ASATs and tracking lots of objects in space, which is becoming more and more important to us.

So deployment of those sensors may be treaty-compliant. We don't know yet and our treaty-compliance people are looking at them.

Now what I am about to describe to you in the interceptors--these clearly are not treaty-compliant when you get to the deployment phase. You can make some arguments perhaps about testing of them, but when you get to deployment, then the interceptors I am going to talk about now would not be treaty-compliant, which says we really need to start to work on just what we are going to do about the ABM Treaty.

Let me, though, describe the ground-based interceptor and then, secondly, the space-based interceptor. The ground-based, interceptors will be fairly light weight, hopefully very, very low cost. They would be deployed in some fashion not all that different from anti-aircraft, surface-to-air missiles, and using the sensors I have just described, would be launched to make a kinetic kill, again, ~~and~~ kinetic is important. In other words, there is no explosive charge of any sort. They simply collide with the reentry vehicles, either in the terminal phase or in the mid-course phase.

Here is the experiment version--one we call the ~~EROS~~ ERIS, on page number 23, and it utilizes in the experimental version, the second and third stage of Minuteman missiles--we make some economies there and then you see blown up what the

guidance and the kinetic kill section of the vehicle looks like.

The next is the space-based interceptor (SBI) and I think that is just very descriptive, the words themselves. It is based in space. These are indeed satellites and, again, use the kinetic kill type mechanism. There is no explosion of any sort involved with them.

On page number 25, you will see the depiction of what the coverage of these would be as they are in orbit. You see the many, many dots on here. Each one of those dots is meant to represent a carrier vehicle. At the time of the DAB, back in October, the carrier vehicle was envisioned to include 10 space-based interceptors. We are looking at different concepts today, but nevertheless, the principle is still the same. Those space-based interceptors would be in these various orbits around the earth, constantly moving, and obviously, there is the capability there to defend not only the United States, but to shoot down ballistic missiles in their boost phase or post-boost phase no matter where they are launched from and no matter where they are going.

So space-based interceptor carries that kind of advantage. It also has the big advantage of being able to hit a missile in its boost phase when it still has all the reentry vehicles on it. You know, the Soviet SS-18 carries--I don't know if this number is classified, so I won't say it, but

the SS-18 carries quite a few reentry vehicles. So ~~the~~ with the space-based interceptor if you can get one missile you can kill quite a few reentry vehicles right there.

When you get to the ground-based system, the ground-based system, then, has to take on each reentry vehicle as it enters the atmosphere.

Mr. DICKINSON. General, the SS-18, if the number of reentry vehicles is classified, who are we keeping it secret from?

General MONAHAN. That is a good question, Mr. Dickinson. I can talk to you later about why I said that, but--

Mr. DICKINSON. Go ahead.

General MONAHAN. Does anybody know the answer? It is not 10. It is not classified, it is 10.

Mr. DICKINSON. Hell, I knew it was 10. Everybody knows it is 10.

General MONAHAN. I know.

If I may, then, review the program here on page number 26. You will note that we tried to lay out when the DEMVAL, the full-scale development and production phases of the program, would occur. Note that the BSTS program, boost surveillance and tracking system, would begin full-scale development earlier than the others and could begin as early as fiscal year 1990.

For the remainder of the systems, we are talking about

getting into about fiscal year 1992 or 1993 before that occurs.

Page number 27 is the depiction of the costs as they were presented at the Defense Acquisition Board last fall, ~~and~~ You will ~~can~~ notice that they went up, and then they came back down, as some major changes were made in the program and the current estimate to proceed with the program, as I just described it, is $69.1 billion, and hopefully, being able to reduce that.

If I may, then, go to the next chart, number 28, and this is perhaps one of the major potential areas for cost reduction, and that is with the Brilliant Pebbles concept. When I described the Space-Based Interceptor~~s~~ a minute ago, I said that they were housed in vehicles that carried 10 apiece. That number is not classified. In the Brilliant Pebbles concept, we would deploy them in singlets. In other words, each missile all by itself. The missile would be--the interceptor would be relatively small, only about a foot long--excuse me, about a yard long, about a meter long, probably weigh about 100 pounds or less, would have some highly dense packaging of the sensors and propulsion system and all that is necessary for it to do its job.

It also differs from our current Space-Based Interceptor concept in that in at least one mode of operation, the Brilliant Pebbles is envisioned to be able to operate

autonomously. In other words, it doesn't have to get hand-offs or information from other sensors.

The sensors on the Brilliant Pebbles would have the capability of detecting launches of boosters and then have additional sensors that could guide it to the target should it be enabled by a decision made by man on the ground to let it fly free, to go destroy a target.

So it has an awful lot of ~~potential, I think, for--and it has a lot of~~ operational potential and ~~I think it has~~ a lot of potential to reduce costs.

At the same time, there is an awful lot that is still unknown about Brilliant Pebbles, and there is a lot of technical work, a lot of research work left to be done. For example, could the several small sensors onboard the singlet--onboard the Brilliant Pebbles indeed be able to detect what we think it has to detect? Could we, indeed, package the electronics into the small space required? We have never mass-produced anything like this before; there has never been mass production of satellites and these Brilliant Pebbles would be both satellites and they are also something like air-to-air missiles. They are kind of a cross between the two. So that makes it difficult to get a handle, without ever having to try to mass-produce them before, ~~it tries to get a difficult--~~it makes it difficult to try to get a good handle on costing them just at this time.

~~But nevertheless~~ Oh, yes, and then there is the communication system that would be required. We would envision deploying these in the thousands, many thousands, and they would have to be hooked together by a very robust communication system.

All ~~of~~ that ~~that~~ I have just described is, I think, doable. I think there is a lot of potential there, but ~~I think that we have to~~ the degree to which you could be successful in a timeframe in which you could be successful and how much it would ultimately cost, I think are all unknowns at this time.

So we are, in our options, looking at--as part of the president's strategic review, we are looking at options that do include robust work as far as Brilliant Pebbles is concerned.

As I said, to wrap it all up, I think there is a lot of potential here with the Brilliant Pebbles program.

Page 29 is just a look, an artist's--no, this is an actual picture of a test vehicle we have there.

Now, from the test of this, I have just described the phase 1 system and described the Brilliant Pebbles. For now, let's start talking about things that would come later, things that will come in phase 2 and beyond.

Again, here is a list of the abbreviations. The HEDI, the space-based laser, neutral particle beam, ground-based

laser, et cetera. The first of those is the HEDI, or the high endoatmospheric defense interceptor. Here, we would have a vehicle that is able to intercept the reentry vehicles while they are in the terminal phase.

On page number 32, there is a picture of a test vehicle that we are going to launch this summer.

Space-based laser. I think the description--the words speak for themselves. Obviously, you hit something with the speed of light. Note, however, it is a very, very, very large satellite. We think about 220,000 pounds. There is an artist's depiction of such a satellite on the next page.

The next is the neutral particle beam device which could be deployed in space. I am on page 35 now.

Mr. DICKINSON. General, is the shuttle--what is capable of putting 220,000 pounds in orbit? Do we have anything--

General MONAHAN. I don't know. I get worried again about classification. I don't know at the present time, Mr. Dickinson, of a vehicle that we have than can do that.

Mr. DICKINSON. I didn't think so. Is that what we call pie in the sky?

General MONAHAN. No, sir. You have perhaps heard of the advanced launch system program, and when you get to space-based lasers or space-based neutral particle beam weapons, then you ~~probably--then you~~ do need something that an advanced launch system could offer. Up until that time, you

probably don't need an advanced launch system.

The neutral particle beam weapon, which destroys simply by shooting hydrogen atoms, is another concept and you can see it it would be a satellite of substantial size, about 116,000 pounds. That, again, is something for the phase 2 or phase 3 program and it is quite a ways out in the future, although some very, very good progress has been made technically in pursuit of this.

Page number 37, I talk about a ground-based laser. Obviously, it can do the same thing as a space-based laser, but on page 38, you note that we have to use relay mirrors in order for it to do its job. So whereas you could keep the laser on the ground, such that it would have access to a very, very large power supply--that is the big advantage of keeping it on the ground--you still have to put satellites in orbit that would have the mirrors on them.

In reviewing the ~~The~~ next couple charts, beginning with number 39, I would like to talk just a little bit about what technology has done in the program. You note there has been about $15 billion invested in the program to date, a lot of technical work under way, and these are just a few examples of some things that have come out.

On page 39, you will note an inertial measurement unit--or inertial navigation sat. From the 1970s, it cost about $70,000 and weighs 41 pounds, and you note that under SDI,

they have developed that now down to the point where it just weighs about eight ounces. It is about this big and costs only about $8000 and has no moving parts. That is just one example.

Another example on page number 40 of what has been done in the way of divert motors. You note the one over there on the left which is of the vintage of the 1960s and coming all the way over to the right, which has been developed now by--through the SDI program. A great reduction in weight, a great increase in thruster weight and a great reduction in cost per unit.

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On page number 41, it shows the same sort of things in computers, and indeed, the generic computer that we would use on various ~~of those~~ sensor platforms that I mentioned is depicted over on the right and you can see the tremendous decrease in size, but the great increase in through-put capacity. Fifteen million instructions per second versus just 3 million instructions per second from older hardware that is much bigger. So that has been developed.

On page number 42, those of you that are familiar with the Maverick missile--here is the device that I don't try to claim can do the same thing that a Maverick can, but the electronics unit inside of the Maverick weighs about 100 pounds and the electronics unit developed here for the leap projectile just weighs half a pound and occupies much less volume.

Those are just a few of the examples of the technology that benefits--not only direct benefit to the SDI program, but is going to benefit many other areas as well.

Just a quick look, beginning on page 43, as to how the budget is broken up ~~First of all.~~ by who manages it--obviously SDIO manages all of it. We use the Air Force and the Army, DARPA, the Department of Energy, DNA, the Navy, also as agents. That first chart just shows how that is broken up.

I then get into the program elements, however, on page number 44. That gives all the information as to how it is divided before the major elements of directed energy weapons, kinetic energy weapons, SATKA, et cetera.

One that is perhaps more important, though, is on page number 45. On page number 45, for 1990 and 1991, it shows how much of the budgets are planned to go towards the phase 1 system, the follow-on systems and the technology. Note about 45 percent or 46 percent is technology and about another 40 percent is in the systems area of phase 1 and phase 2 systems.

With that, just a couple of words of summary, Mr. Chairman. There has been substantial investment in the program, a lot of technology advancements have ~~has~~ been made and the current budget, as it was put in, maintains a balanced program and then pursues the phase 1 effort that I talked about throughout this presentation.

With that, Mr. Chairman, I would like to make some comments about some of the questions that were asked here just a little bit earlier by yourself and by Mr. Dickinson.

First of all, Mr. Dickinson asked about what is my view of the role of the program manager and I agree with him, the program manager, the role that I have, should be that of the person that asks ~~says~~ what can we do, rather than what should we do? In other words, I think that I should be required to

give you as objective an assessment as I can of things such as ~~that~~--technical risk, technical difficulty, cost assessment, schedule assessment. I should be able to tell you what we can do and the should do, I think, requires a much, much bigger forum and a much broader forum.

That is what is encouraging about the strategic review that is under way at the present time, because we now have the defense and the offense being considered together in that strategic review. I think that is providing that kind of forum.

For that part, our organization is making a lot of input on various options as far as the strategic review is concerned. We are telling people, just as I said, how tough is it to do technically? Is it possible to do it technically? How much does it cost? How long does it take, and answering those kinds of questions.

I think Mr. Dickinson also asked about my view on fencing. No program manager that I have ever known ever likes to see his funds fenced. Why? It is very simple. It just takes away flexibility that he has in pursuit of the program. Now, the flexibility he has to have when a program is way downstream in production is nowhere near the kind of flexibility he has to have when a program is way up front in research, in the research and development phase. That is exactly where we are at the present time.

We have not entered full-scale development of any element of SDI. Rather, we are still in the demonstration/validation phase and in that phase, you have to make lots of tradeoffs, first of all, between--you know, should I have the SSTS do this or the BSTS do this or is it better to have that done on the ground or in space? You have to make those kinds of tradeoffs as specifications start to get tightened up.

So it is very important at this stage of the game, it seems to me, if we put together a balanced program that we avoid fencing, if at all possible.

Let's see--oh, you asked, Mr. Dickinson, also, about the SBI. It was down-scoped, and that happened because ~~of the~~--when the fencing initially occurred and was in the proposed legislation, the SDI organization took it on itself to reduce that because it looked like they wouldn't be able to spend it anyhow. As a result, I guess some people got laid off and some bad things happened there. It never get restored as back as far as we want it.

Mr. Chairman, ~~that from~~ according to my notes, I think ~~those are~~ [illegible] the questions that you asked very specifically about and I will be happy to take any other questions you may have.

[The statement of General Monahan follows:]

*********** INSERT 2-1 ***********

STATEMENT ON

# THE STRATEGIC DEFENSE INITIATIVE

BY

LIEUTENANT GENERAL GEORGE L. MONAHAN
DIRECTOR
STRATEGIC DEFENSE INITIATIVE ORGANIZATION

BEFORE THE

SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT
COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

101st CONGRESS, FIRST SESSION

MARCH 14, 1989

Thank you for the opportunity to appear before this Subcommittee today to testify in support of the SDI budget request.

As you are aware, the top-level strategic review and revisions to the President's budget may result in an adjustment to the budget request for SDI and other programs. At present, however, the objectives of the research remain constant and are shown below:

Figure 1. SDI Objectives

## SDIO OBJECTIVES

- Conduct Vigorous Research Program To Develop Key Technologies For Defense Against Ballistic Missiles
- Consider Options To Increase The Contribution Of Defenses To US And Allied Security
- Protect Options For Near-Term Deployment Of Limited Ballistic Missile Defense
- Carry Out Program In Full Consultation And, Where Appropriate, With Participation Of Our Allies

The SDI budget request is $5.6 billion and $6.7 billion for fiscal years 1990 and 1991, respectively. The following charts provide details.

Figure 2. FY 1990-91 Budget Compared To Past Appropriations

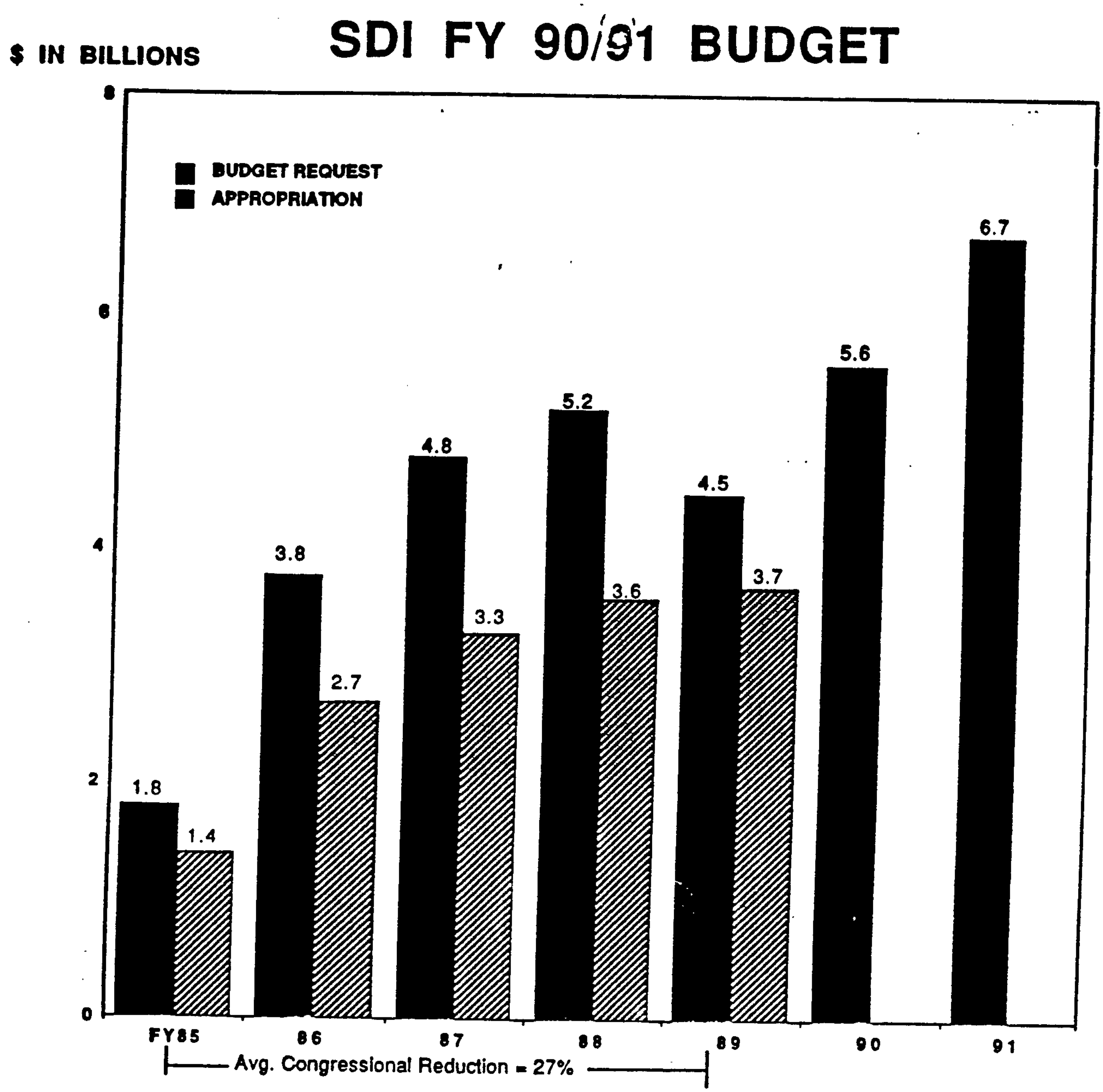


Figure 3. SDIO RDTE Funds by Program ($ million)

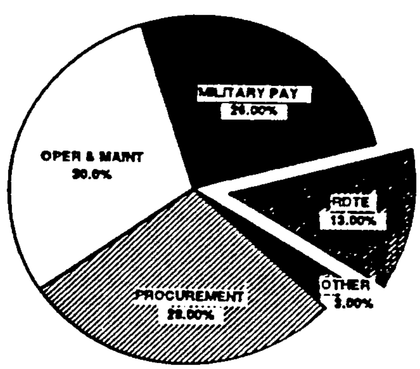
| | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 |
|---|---|---|---|---|---|---|
| Sensors | 844 | 923 | 935 | 1101 | 1281 | 1436 |
| Directed Energy | 796 | 853 | 934 | 820 | 1117 | 1323 |
| Kinetic Energy | 596 | 723 | 773 | 773 | 1346 | 1534 |
| Systems Analysis/ Battle Mgmt | 212 | 386 | 461 | 506 | 781 | 976 |
| Survivability, lethality, and Key Technology | 214 | 375 | 430 | 406 | 777 | 948 |
| Boost Surveillance and Tracking System - Full Scale Development | | | | | 262 | 427 |
| HQ MGT | 13 | 20 | 20 | 21 | 26 | 27 |
| Total | 2675 | 3280 | 3553 | 3627 | 5590 | 6671 |

Figure 4. SDIO Budget Request Compared To Other Accounts

12489-12

## SDI FY 90/91 BUDGET

SDI FY 1990/1991 DOD BUDGET
BUDGET AUTHORITY BY APPROPRIATION




FY 90 = $305.6 BILLION
FY 91 = $320.0 BILLION

RDT&E
$ IN BILLIONS

| FY90 | FY91 | |
|---|---|---|
| 4.9 | 5.3 | - DEF AGY - NON SDI |
| 5.6 | 6.7 | - DEF AGY - SDI |
| 5.6 | 5.9 | - ARMY |
| 10.2 | 9.6 | - NAVY |
| 14.8 | 13.8 | - AIR FORCE |
| 41.1 | 41.3 | - TOTAL |

SDIO AS PERCENT OF

| | DOD | RDTE |
|---|---|---|
| FY88 | 1.35% | 10.05% |
| FY89 | 1.2% | 9.7% |
| FY90 | 1.8% | 13.6% |
| FY91 | 2.1% | 16.2% |

Figure 5. Distribution of SDIO Funds by Project

| PE # | PROJECT # | TITLE | FY89 $ Actual | FY90 $ APPN | FY90 $ Request | FY91 $ Request |
|---|---|---|---|---|---|---|
| 0603220C | | Surveillance, Acquisition, Tracking, and Kill Assessment Projects | | | | |
| | 01 | Radar Discrimination and Data Coll | 16.267 | 21.175 | 28.995 | 29.952 |
| | 02 | Optical Discrimination and Data | 99.078 | 110.994 | 123.822 | 163.747 |
| | 03 | Microwave Radar Tech | 17.299 | 14.323 | 28.966 | 28.963 |
| | 04 | Laser Radar Tech | 79.850 | 80.771 | 98.852 | 101.899 |
| | 05 | Passive Sensor Tech | 85.841 | 71.299 | 96.884 | 105.842 |
| | 06 | Signal Processing Tech | 88.122 | 81.943 | 100.848 | 108.827 |
| | 07 | Interactive Disc Tech | 23.141 | 13.980 | 37.841 | 41.832 |
| | 08 | Boost Dem/Val | 173.993 | 236.000 | 67.511 | 0.000 |
| | 09 | Midcourse Dem/Val | 37.745 | 107.986 | 163.784 | 314.816 |
| | 10 | Midcourse Experiment | 99.701 | 93.891 | 42.930 | 29.963 |
| | 11 | Terminal Dem/Val | 38.882 | 72.393 | 144.475 | 180.343 |
| | 12 | SATKA Support | 117.215 | 122.990 | 217.548 | 214.114 |
| | 81 | IS&T | 98.374 | 43.299 | 98.605 | 114.886 |
| | 82 | Delta Star | 7.900 | 0.000 | 0.000 | 0.000 |
| | 83 | Support Programs | 43.510 | 31.881 | 32.982 | 35.018 |
| | | TOTAL SATKA | 984.908 | 1100.725 | 1281.023 | 1438.000 |
| 0603221C | | Directed Energy Projects | | | | |
| | 20 | FEL | 172.065 | 202.322 | 275.082 | 302.010 |
| | 21 | ATP | 252.348 | 183.891 | 254.617 | 244.810 |
| | 22 | CL | 100.080 | 100.139 | 348.486 | 511.190 |
| | 23 | NPB | 109.018 | 98.998 | 114.829 | 114.786 |
| | 24 | MIRACL/T | 27.900 | 4.000 | 0.000 | 0.000 |
| | 25 | CDTV/Emerging Tech | 167.142 | 96.153 | 84.729 | 62.462 |
| | 81 | IS&T | 19.315 | 15.000 | 34.130 | 40.985 |
| | 82 | Delta Star | 65.218 | 72.962 | 0.000 | 0.000 |
| | 83 | Support Programs | 21.810 | 46.884 | 27.059 | 17.274 |
| | | TOTAL DEW | 934.296 | 819.759 | 1116.922 | 1322.877 |
| 0603222C | | Kinetic Energy Projects | | | | |
| | 30 | Space Systems | 165.000 | 132.000 | 346.296 | 380.412 |
| | 31 | Exo KKV Systems | 116.000 | 202.255 | 244.225 | 293.819 |
| | 32 | Endo KKV Systems | 106.250 | 145.875 | 218.564 | 191.488 |
| | 33 | Advanced Tech Weapons | 117.582 | 89.105 | 217.673 | 311.507 |
| | 34 | Test and Evaluation | 133.105 | 88.015 | 107.137 | 145.685 |
| | 35 | Technology Support | 8.658 | 9.405 | 9.586 | 9.545 |
| | 42 | Theater Defense | 67.958 | 75.787 | 139.290 | 149.957 |
| | 81 | IS&T | 23.365 | 21.702 | 41.277 | 49.190 |
| | 82 | Delta Star | 6.147 | 0.000 | 0.000 | 0.000 |
| | 83 | Support Programs | 32.102 | 28.967 | 22.467 | 22.974 |
| | | TOTAL KEW | 773.167 | 773.111 | 1346.514 | 1534.557 |
| 0603223C | | Systems Analysis and Battle Management Projects | | | | |
| | 40 | SDS Engineering and Support | 72.590 | 82.096 | 131.407 | 201.071 |
| | 42 | Theater Defense | 90.500 | 30.805 | 48.922 | 46.720 |
| | 43 | CC/SOIF Technology | 64.306 | 58.572 | 86.368 | 107.817 |
| | 44 | CC/SOIF Experimental Systems | 91.073 | 74.179 | 143.778 | 203.071 |
| | 45 | National Test Bed | 77.713 | 100.179 | 115.827 | 121.802 |
| | 46 | SDS Phase I Engineering | 45.201 | 63.470 | 125.210 | 155.531 |
| | 47 | Test & Evaluation | 5.961 | 8.477 | 9.985 | 14.977 |
| | 81 | IS&T | 12.985 | 16.350 | 25.832 | 30.802 |
| | 83 | Support Programs | 22.962 | 53.269 | 70.858 | 70.871 |
| | 85 | Technology Applications | 16.465 | 20.277 | 22.967 | 22.965 |
| | | TOTAL SA/BM | 481.459 | 505.476 | 780.854 | 973.827 |
| 0603224C | | Survivability, Lethality, and Key Technology Projects | | | | |
| | 50 | Systems Survivability | 91.305 | 102.991 | 169.450 | 218.114 |
| | 51 | Lethality and Target Hardening | 68.641 | 62.218 | 124.434 | 152.129 |
| | 52 | Power and Power Conditioning | 97.204 | 99.509 | 206.295 | 236.979 |
| | 53 | Space Transportation and Support | 79.558 | 85.000 | 124.809 | 154.750 |
| | 54 | Materials and Structures | 24.890 | 30.731 | 68.428 | 86.061 |
| | 55 | Countermeasures | 21.245 | 22.270 | 34.994 | 42.356 |
| | 81 | IS&T | 23.600 | 19.376 | 40.905 | 48.610 |
| | 83 | Support Programs | 23.131 | 15.248 | 8.472 | 8.578 |
| | | TOTAL SLKT | 429.574 | 406.343 | 776.787 | 947.576 |
| 0604220C | 80 | BSTS FSD | 0.000 | 0.000 | 262.000 | 427.000 |
| 0605898C | 83 | Management Headquarters | 20.026 | 21.000 | 26.394 | 27.454 |

The classified FY 1990 Report to Congress on the SDI Program was submitted to the Congress on January 19, 1989. The unclassified version of that report should be available soon. This report describes in detail the content of the total SDI research program. With your indulgence, I would like to take a few minutes to highlight some very important points from the report. First, the SDI research program seeks both mature and emerging defense options. For example, kinetic energy systems (e.g., rocket-propelled interceptors) -- which will be deployed in the initial phase of a defensive system -- and directed energy weapons (lasers, particle beams) are being researched with equal dedication. Second, the emerging defense options are integral to the program's success in countering potential Soviet responses to a deployed Strategic Defense System (SDS).

In October, 1988, the Defense Acquisition Board (DAB) completed an annual progress review of the technologies previously selected for the demonstration and validation phase of the Defense Acquisition Process. These technologies, constituting Phase I of the Strategic Defense System (SDS), are ground- and space-based sensor systems, ground- and space-based ballistic missile interceptors, and Battle Management, Command, Control and Communications.

Prior to development and deployment, any SDS must demonstrate an ability to meet the requirements of military effectiveness, survivability, and cost effectiveness. The focus of the research into SDS/Phase I elements is to develop Phase I technologies which can meet these requirements. We are encouraged by our progress.

Cost reduction has long been recognized as an important component of the SDI program, and cost-reduction efforts have been emphasized in tandem with technology research. By anticipating potential SDS costs, and by implementing technology development strategies that focus on reducing costs, we believe the SDS will be affordable. As Lieutenant General Abrahamson testified last October to the joint committees on Armed Services, the current estimate of the total cost to demonstrate, validate, develop and deploy the first phase of a SDS is $69 billion. This figure is a substantial cost reduction from earlier estimates, and we expect even further reductions as architecture refinements, new manufacturing techniques and other improvements are made. The reduction to $69 billion was achieved largely through eliminating unnecessary redundancy, increased space-based interceptor performance (resulting in the need for fewer interceptors), and from more capable sensor technology and design. We will continue efforts to both develop systems which are cost effective and seek trade-offs where possible to reduce overall investments.

I would like to review for this Committee the major, mature technologies/system elements which could make up an effective defensive system. The hardware specifications for such an initial defensive system, Phase I, are not absolutely fixed; as continued progress is seen in the demonstration/validation effort, and in technology development, we may substitute or add more promising technology.

SENSORS

Boost Surveillance and Tracking System (BSTS). The BSTS is a missile launch warning system to detect launches of ICBMs and SLBMs. The sensors in BSTS satellites detect and track infrared emissions of a missile's propulsion system. Technology programs, ground demonstrations, and measurement programs are in process and focus on developing a complete understanding of the phenomenology and system design requirements. Ground demonstrations are scheduled to support both a system design selection and a full scale development decision in mid-year 1990. Currently, two contractors are finalizing their individual system design concepts. The first BSTS deployment is planned for the mid-1990s.

Space-Based Surveillance and Tracking System (SSTS). The SSTS is a constellation of satellites and ground stations. The primary sensing payloads of the satellite are a Long Wave Infrared (LWIR) passive sensor and a visible/ultraviolet passive sensor. The primary mission of SSTS is to track Post-Boost Vehicles (PBVs), target clusters, and Anti-Satellite Weapons (ASATS) to support defensive weapon engagement. The SSTS will also be able to track and discriminate a small number of RVs and perform foreign target signature collection and satellite tracking functions. The SSTS may provide weapon target assignment, fire control and inflight updates for Space Based Interceptors during post boost and early midcourse phases of flight. Initial design validation will be accomplished by an end-to-end ground demonstration scheduled for 1992 and will be the basis for downselection to a single contractor who will

produce the satellite.

Ground-Based Surveillance and Tracking System (GSTS). The GSTS is a fast-response, two stage, rocket-launched long wavelength infrared (LWIR) sensor system boosted into suborbital flight for use in the midcourse phase. The GSTS sensor operation is integrated with SSTS and GBR operations to provide track and discrimination. GSTS sensors are launched on selective trajectories based on early attack assessment data provided by the BSTS, SSTS, and other early warning sensors. The GSTS sensors would not be committed until the threat is launched to provide best GSTS inventory usage to increase the overall effectiveness of the SDS. GSTS enhances strategic defense robustness by providing a reconstitution capability in the event of an SSTS outage, to fill gaps in SSTS coverage, and to augment SSTS viewing in high density traffic situations.

A single contractor is developing concepts and multiple sensor designs. Sensor design will be selected based on technology experiments and sensor test bed results. A flight-qualified payload design will be developed and then fabricated for hardware-in-the-loop ground test demonstrations in FY92.

Ground-Based Radar (GBR). The Ground-Based Radar -Experimental (GBR-X, formerly named the Terminal Imaging Radar) is a phased-array, technology demonstration radar to be used for experiments at the U.S. Army Kwajalein Atoll for multi-target acquisition, tracking and discrimination in the midcourse and high endoatmospheric phases. It will accept hand-over from other midcourse sensors. The previous radar design was modified

in 1988 to operate in the midcourse region. This design facilitates integration with both ground and space based interceptors. The follow-on Ground-Based Radar program will develop a tactical, late midcourse defense radar to meet the ballistic missile threat, as an deployment system option for the SDS.

DEFENSIVE INTERCEPTORS

Ground-Based Interceptor (GBI). The GBI is an exoatmospheric interceptor to perform preferential and adaptive defense of selected targets. A Demonstration/Validation flight test series is intended to demonstrate, in FY 90-91, a LWIR seeker against a representative target complex (including decoys and countermeasures). Preparations are being made to develop and integrate the advanced technology required for engineering development. We plan to flight test these technologies in the 1991-92 time frame.

Space-Based Interceptor (SBI). SBI obtains the maximum defense leverage by intercepting boosters and post-boost vehicles before they have a chance to deploy reentry vehicles and clouds of decoys. SBI also has the additional capability to intercept re-entry vehicles and anti-satellite weapons, as the threat changes, with increased defensive benefits. Although the present architecture calls for SBIs to be garaged in groups of ten, the interceptors could be deployed as free flying "singlets" as proposed in the "Brilliant Pebbles" concept, with modification to battle management and surveillance requirements.

Technology simulation and tests are in progress to support the optimization of a low cost SBI. In particular, hover

testing at Edwards Air Force base and Sensor/Sensor Processor testing at Eglin Air Force Base in FY89 and FY90 will investigate the bounds of interceptor performance. These ground tests will be augmented, in the FY90 to FY92 period, with ballistic tests of SBI subcomponents at the White Sands Missile Range. In FY93, ballistic intercepts will be conducted at the Kwajalein Missile Range. These tests will complete preparation for a Full Scale Development Decision in FY94.

BATTLE MANAGEMENT/COMMAND, CONTROL, COMMUNICATIONS

This component has been designated the Command Center/System Operation and Integration Functions (CC/SOIF). The Command Center element will provide positive, survivable, and secure human control over the SDS. It will consist of fixed and mobile units and a terrestrial communications network with ground entry points for interconnectivity to the space components. CC also supports coordinated offense-defense operations and interfaces with other U.S. government agencies.

The System Operation and Integration Functions include the distributed information processing network needed for the automated execution of a human-selected battle plan. This requires both the assured, secure exchange of information between the CC and all SDS elements, and the data processing to identify targets, allocate weapons, execute the defense and assess its success, and manage the system's resources.

A baseline CC/SOIF architecture has been identified, with automated decision functions allocated to interceptor and sensor elements. Software policy, based on the recommendations of the Defense Science Board, emphasizes standardization,

supportability, risk reduction, security, reusability, and documentation.

In the coming year, the CC/SOIF program will:

- Develop a pilot Command Center experiment to resolve issues,

- Develop and refine Sensor Planning Algorithms for the Phase I design,

- Conduct advanced CC/SOIF simulations to test integrated system operations,

- Refine the content of ongoing experimental activities,

- Accelerate the use of available data from multiple experiments.

An Experimental Version of the CC/SOIF element should be available in FY 1994, with prototype CC/SOIF participating in realistic integrated tests with other SDS elements beginning in FY 1996.

<u>ADVANCED TECHNOLOGIES.</u>

Subsequent deployments, necessary to maintain and improve the initial defensive system capability, may include some or all of the following major candidate systems, depending on the threat response and the technological progress. Or, if more promising, one of these could be moved to the initial phase. There are still many unknowns associated with these technologies and a significant investment is necessary to resolve the unknowns.

<u>Singlets</u>. The concept of a singlet, in which the total surveillance is built into the interceptor, is embodied in a concept called Brilliant Pebbles. This interceptor would be

completely autonomous. Given a release command, the interceptor would use its own sensors to acquire a target and engage it without external tracking data or other assistance.

The interceptor should be low cost because it is derived from pervasive use of miniaturized commercial and military "off-the-shelf" high technologies, including miniaturized high-resolution/wide-field-of-view video imaging systems that work from the mid-UV to the mid-IR range, a super computer with Cray-I performance operating off high-energy-density "D-cell" sized batteries, a miniaturized high-power laser imaging radar/communications system, and a high-mass monopropellant propulsion system.

This interceptor's passive features -- small size, low cost, autonomy, and dispersal ability as singlets -- would be jam resistant, provide low-detection cross section, enable interceptors to be supplemented by decoys, and provide low value per individual target. These features would be supplemented by a full nuclear survivability suite and extensive maneuver capability for breaking track, evasion, and antisimulation in conjunction with constellation decoys.

<u>High Endoatmospheric Defense Interceptor (HEDI).</u> HEDI is a hypervelocity missile with a non-nuclear warhead that provides endoatmospheric (terminal phase) defensive coverage against ICBMs and SLBM RV's. The contribution of HEDI to the SDS architecture would be an additional defensive layer to further reduce RV leakage rates. The HEDI research is focused to resolve technology issues dealing with aero-optical effects, window and forebody cooling, shroud removal, non-nuclear warhead

kill and guidance and controls. The FY90 request supports the second major flight experiment (KITE-1) in which the IR passive seeker will be demonstrated, and several key ground tests to obtain significant optical and thermal data. The HEDI project is probably the most mature follow-on element and could enter into Demonstration/Validation (a Milestone I decision) in FY 90, if required.

Neutral Particle Beam (NPB). Orbiting stations would produce beams of neutral particles sufficient to destroy boosters and reentry vehicles, and provide interactive discrimination between warheads and decoys. A Milestone I decision is planned in the early 1990s, with a Milestone II decision in the mid-1990s.

Space Based Laser. Orbiting stations would produce laser beams sufficient to destroy boosters, post-boost vehicles, provide interactive discrimination, and provide self-defense capability for SDS elements. A Milestone I decision is planned for early 1992, with a Milestone II decision in the mid-1990s.

Ground Based Free Electron Laser (GBFEL). Protected sites in the United States would produce high energy laser power, relayed through space by mirrors, sufficient to destroy boosting missiles and to provide interactive discrimination. A Milestone I decision is planned for the early 1990s, with a Milestone II decision in the mid-1990s.

There are many other components of the SDI research effort, each with a supporting series of technology base research and experiments. Examples are the many sensors, processors and control elements associated with the sophisticated acquisition,

tracking, pointing and fire control necessary to orchestrate the multiple autonomous functions of the directed energy systems. We have attempted to detail in the Report to Congress the complete extent of the research.

The Report to Congress on the SDI program also contains information regarding SDI's compliance with the ABM Treaty. As has been the case since the SDI program inception, planned tests and experiments for fiscal years 1990-91 are in full compliance with the ABM Treaty. All tests are reviewed in detail by the Department of Defense (DoD) Compliance Review Group to assure such compliance. This review process is a deliberate, vigorous study of plans and treaty consideration.

Last year's Defense Authorization Act (Section 224) required a report on the feasibility of an accidental launch protection system. As you are aware, the Administration is conducting a comprehensive strategic review. The Department is very actively involved in that review, which includes consideration of the optimal SDI program. The Report on ALPS will be submitted as soon as possible upon completion of that review.

I would like to touch briefly on one other item before I proceed to highlight our technical progress this past year. You may be aware that the SDI research involves our Allies. The President's original guidance and SDI's charter reflected a concern for both U.S. and Allied security and stressed the development of ballistic missile defense technologies for threats of all ranges. Most of our Allies support the SDI research effort and, within the established DoD competitive

contracting procurement procedures, are actively participating with valuable technical contribution to the program. Since, SDIO's mandate extends to examining technologies for theater missile defenses, the Fiscal Year 1990 program will include analyses, technology developments and experiments that will improve our understanding of the theater defense problem. Technical programs include hypervelocity gun experiments, radar analyses, lethality studies, and theater test bed development. In several cases, our Allies are working cooperatively with us as we proceed in this area. A notable experiment will be the U.S./Israeli missile engagement experiment titled ARROW.

SDI research accomplishments have increased our confidence that strategic defenses will prove feasible. In past years, the SDI Organization has conducted a series of kinetic energy and directed energy weapon technology tests. Kinetic energy tests have successfully demonstrated the capability to intercept and destroy -- by non-nuclear means -- enemy ballistic missiles before they reach their targets. The first of a series of "hover tests" of a space-based interceptor have been conducted in a ground test facility. These tests help evaluate the capability of fast acting thrusters to keep a sensor pointed at a target, and the interaction of the sensor and guidance systems. This past year the Aerothermal Reentry Experiment (ARE) demonstrated that kinetic energy weapons can destroy warheads not only with a perfect hit, but also by inflicting damage with a less than perfect collision. ARE demonstrated the process of self-destruction of a damaged warhead as it enters the atmosphere. We will continue work over the next two years

toward integrated flight tests which will demonstrate with sufficient confidence that ground-and space-based interceptors can in fact satisfy the requirements for the first phase of a defensive system.

With directed energy experiments, researchers have demonstrated several key principles related to the operation of a large Free Electron Laser, a weapon which could become powerful enough to destroy enemy ballistic missiles in the boost and post-boost phases of flight. The Free Electron Laser has demonstrated lasing which shows wavelength scaling beyond that needed for an operational defense system. Similar experiments are also being conducted using other types of lasers and neutral particle beams. While lasers and particle beams will not be available as soon as some of the kinetic energy systems, their importance to the overall SDI mission cannot be overstated. Although such systems would build on the capability of an initial system, they would have at least one new mission: to thwart the effectiveness of a new generation of Soviet ICBMs and other possible counters to an SDS. Kinetic energy systems, lasers, and particle beams form what might be considered a mutually reinforcing "triad" of defensive systems much like the mutually reinforcing and complementing aspect of the offensive Triad. Additionally, by following the system design approach which we call "branch and block," we can frustrate threat evolution by maintaining an ever present capability to expand the SDS to meet the threat.

We have continued to exploit the successes of earlier experiments which demonstrated substantial improvements in our

ability to develop sensors necessary for strategic defenses. Last year's DELTA 181 experiment provided valuable information on the signatures of midcourse targets. The assortment of active and passive sensing instruments accurately characterized the test objects, and also the launch of a research rocket, in a variety of space environments. This data is being used to develop effective algorithms for discrimination between decoys and reentry vehicles.

Some surveillance and sensor technologies supported by the SDI program address not only SDI but other critical national security needs as well. The capabilities of today's early warning radars and satellites could be greatly improved through advancements in detection capabilities. New sensors will provide more accurate and reliable surveillance data of objects in space.

Tangible, impressive results have given us increased confidence that strategic defenses are feasible. Our progress has been excellent but we still have much left to do. Unanswered technical issues exist even though we are making great strides in fully understanding strategic defenses. The principal uncertainties of ballistic missile defense have been recognized for several years; these center around three issues: 1) assured survivability of space-based elements, 2) early interception of boosters and post-boost vehicles, and 3) discrimination. We have programs actively pursuing resolution of each of these issues.

Our schedule for the next two years includes a number of very important tests and experiments. Again, each of these is

fully compliant with all treaty obligations. I would like to briefly highlight a few upcoming projects and experiments, their contribution to the research program and the issues which will be addressed (from the three listed above).

| Experiment | Objective | Issues Addressed |
|---|---|---|
| Delta Star | Collect multispectral imagery of rocket plumes and the near-space environment. | 2, 3 |
| Beam Experiment Aboard Rocket (BEAR) | First test of a Neutral Particle Beam in space. | 1, 2, 3 |
| Laser Atmospheric Compensation (LACE), Relay Mirror (RME), Experiment | Space test of relay mirror and atmospheric compensation process for ground based free electron laser. | 1, 2 |
| STARLAB | Space test of tracking/ pointing, sensor and communication technologies. | 1, 2 |
| Space Power Experiment Aboard Rocket (SPEAR) II | Space test of high power electricity applications. | 2 |
| Airborne Optical Adjunct Infrared Experiment | Airborne test of LWIR sensor. | 2, 3 |

The budget request supports both Phase I and technology for follow-on phases. Phase I elements are currently in the Demonstration/Validation phase of the Defense Acquisition process and will enter Full Scale Development in the next 3-4 years. This system will support the minimum requirements, established by the Joint Chiefs of Staff for a strategic defense system that has military utility. Subsequent phases will build on that system, as necessary, to maintain military utility.

I am happy to answer any questions you may have.

Mr. DELLUMS. Thank you very much, General Monahan, for your opening statement and the Chair would like to indicate to my colleagues that, as you are aware, normally the Chair has deferred to my colleagues to ask questions and reserved the Chair's time to ask questions at the end of the debate, but I would like to depart from this today. There are several important questions that I think need to be raised, and the Chair would like to raise them at the outset of these hearings in the hope that it will aid in the clarification as the debate goes forward.

General Monahan, I realize that you are new to this job. President Bust does not at this moment have a Secretary of Defense. The strategic review is taking place and a budget reassessment is also taking place. Those limitations notwithstanding, I do choose to proceed with some questions in the hope that you will be able to answer the questions in whole or in part.

My first question goes to the conceptual issue of the Strategic Defense Initiative. Now, President Reagan had a vision of SDI as a laser-based population shield which, while politically appealing, apparently had little basis in the actual direction of the Strategic Defense Initiative Office and program spending. Most SDI funding, however, was actually directed at developing systems to protect missiles, not people, and using the so-called more mature existing

technologies.

The initial pronouncements of President Bush have apparently down-played what I perceive to be this unrealistic population shield concept or what we call the Houston Astrodome mentality. Would you comment on the Bush Administration's position concerning the direction and emphasis of SDI under the Bush Administration and can we, at this point, dispense with the public relations approach and now debate the advisability of proceeding with an anti-ballistic missile defense system to protect our land-based deterrent forces so that the debate now will occur on whether there is efficacy in going forward with the land-based--a system to protect our land-based missile system and get away from the discussion of population shield as a nonviable option?

General MONAHAN. Sir, as I mentioned earlier, and you also mentioned, we have the strategic review under way and I think the president's views will come out as that review is completed and as he has the opportunity to review ~~that and~~ included in there will be what the pathway should be for SDI, among other things. So that is where that will come from.

Just a couple of other comments, however. Protecting people or protecting systems--a space-based interceptor, a space-based system that I described, can protect anything

you want it to protect in the entire world. I don't care what it is, you can protect it, people, places, wherever.

In the ground-based system, again, you have the choice. You can--depending upon how many ground-based interceptors and radars and GSTSs we would deploy, we can protect the entire United States or the entire North American continent or wherever you want to put them. You are just wide open to choose ~~choice~~ as far as that is concerned. Don't ~~anybody~~ make the mistake, however, of saying that all reentry vehicles or all missiles coming our way would be shot down. That is just not, I don't think, going to happen. But nevertheless, the system ought to be designed to be robust enough to shoot down a large number.

You can design a system to protect whatever it is you choose, people, places, things, and you probably can be able to do all.

Mr. DELLUMS. So I can conclude from your comment that this debate will continue to go forward as population shield and point defense simultaneously? You don't perceive whether some decision will be made to abandon this broader concept, because many people in Washington believe that what is envisioned at this point is focusing in on a point defense system, as opposed to this population shield that President Reagan sold to the American people as an Astrodome over the nation?

You just think that that decision is not going to be made at this point?

General MONAHAN. No. First of all, as I said, there are just so many options as to how one may go about it and how large an area we wish to protect. Depending upon how many interceptors, radars, ~~and~~ et cetera the country should wish to have and you want a limited protection system, that sort of thing. Do you want to start off small and grow? There are a lot of different options there that could be pursued.

Mr. DELLUMS. My second question goes to the issue of the nuclear energy--use of it in this system. As you know, President Reagan has made much of the program being non-nuclear, and on a number of occasions to the American public, stated that this system was non-nuclear. Nevertheless, substantial SDI funds have gone to examining nuclear energy, both as a power supply and a source of weapons, including orbiting nuclear reactors and x-ray laser programs.

Would you comment, General, on the role of nuclear energy as both a potential power source and a weapon source within SDI? Can we now openly recognize that a significant part of the SDI program is, in fact, nuclear?

General MONAHAN. First of all, Mr. Chairman, the entire phase 1 system is non-nuclear. There is nothing nuclear in it at all. Where you will find nuclear type work is in

looking at the advanced systems and the power supplies for the advanced systems in particular. I described a space-based laser and ~~a space based laser may.~~ it may need a nuclear power supply to be effective. We don't know yet, but because that is the case, we have technical work under way on nuclear power sources in space, just as the Soviets already have today. ~~We don't have, but~~ the Soviets do have nuclear power sources in space, so we do have work under way to see ~~--you know, can~~ whether we can do that and if we need it for a space-based laser, that is the major reason.

But the phase 1 system, today's system, the system ~~I~~ described in phase 1, which is quite robust, uses only kinetic kill type vehicles, does not require nuclear energy of any sort.

Mr. DELLUMS. General, you commented that beyond phase 1, that--and you used the term ''may'' require a nuclear power source, can you comment to the issue of the role of nuclear energy as the source--weapon source beyond phase 1?

General MONAHAN. There is a concept of something called an x-ray laser that would use a nuclear burst to generate the lasing power ~~and that~~--in space~~--and~~. that is a concept. Now, I don't know of--I am a little bit too new to the program to know what kinds of funds we may have looking at that particular effort.

Maybe someone else knows, but I can tell you--I think I

have learned in the past couple of months the major thrust of this program, and that one has never come up. Whatever is going on there--I don't know what it is--it has to be way over on the back burner.

Mr. DELLUMS. General, my third question goes to the debate regarding ABM Treaty. As you recall, there has been a great deal of discussion in the Congress, both the House and the Senate, with respect to questions of violations of ABM Treaty, and there is a long lengthy discussion of the narrow interpretation versus the broad interpretation, which I frankly thought was a gross waste of time and an irrelevant discussion that there is a much more basic and fundamental question regarding SDI and ABM that was not being touched in the narrow discussion of whether a broad or narrow interpretation, but a much more fundamental issue going to the logic of the ABM Treaty on the one hand and the logic of the Strategic Defense Initiative on the other, and my question is designed to elicit a response from you in that regard.

The whole purpose, it seems to me, of SDI is to prevent ballistic missiles from reaching our territory. By definition, then, it is an anti-ballistic missile defense program. Therefore, SDI would violate both the terms and, in my opinion, the logic of the 1972 Anti-Ballistic Missile Treaty.

While debate exists concerning at what point SDI tests would technically violate the treaty, it would necessarily be violated in the next several years anyway so the discussion of whether this test or that test violates the treaty, down the road, you are going to confront the treaty in very real terms.

More important, SDI would lead to the same offensive and defensive arms races that the ABM Treaty sought to avoid. The treaty was agreed to because the parties understood that absent the treaty, there would be a missile defense arms race and a corresponding offensive arms race to overwhelm the developing defenses system. SDI is, at a minimum, an ABM system; thus the logic of ABM applies directly to any SDI.

Therefore, is it not correct, General, that any deployment of SDI would, by definition, be inconsistent with and require an abrogation of the ABM Treaty?

General MONAHAN. I think the simple answer to that question is yes. As I mentioned in my briefing, the deployment of the Space-Based Interceptors or Ground-Based interceptors in excess of 100 (100 ~~are allowed.~~ ground-based interceptors, are allowed by the treaty) ~~In excess of that~~ is not in compliance with the treaty.

So you could not deploy the phase 1 system I described with the treaty as it stands today.

Mr. DELLUMS. Thank you for your candor, General. I will say to my colleagues that the significance of the General's answer is that the debate over narrow versus broad interpretation focuses on the issue of specific tests and whether they violate the treaty, but as--what the General is saying in very clear and unequivocal terms is that if you are going to proceed with SDI, you are going to have to abrogate the treaty, which means you have to come to grips with that issue because the logic of the two are in direct conflict with each other.

My next question is an offshoot of that. Even absent full deployment of any SDI, the testing of SDI components, which are by definition ABM components, would violate that portion of the ABM Treaty. How can we proceed with development and testing of SDI unless we are committed to the abrogation of the ABM Treaty?

Also, could you comment on which specific SDI--and I am not sure if you can do this now, but I would appreciate it if you could--could you comment on which SDI program experiments might possibly be construed as violating the ABM Treaty and the date you anticipate that those particular experiments or tests would be undertaken? You alluded to one. Is that possible for you to discuss what you perceive a test that would be violative?

General MONAHAN. I can just make this statement right

now, Mr. Chairman. All the tests that we have planned for fiscal year 1990 and fiscal year 1991 are treaty-compliant. We have already made that determination in the Treaty Compliance Review Group and it has given us the go-ahead. We have looked at some 25 or 30 tests and experiments right now that have been determined to be treaty-compliant.

We are not putting any funds in the next two years into anything, test-wise, that is not, indeed, treaty-compliant.

Beyond that, you need to take a look at the tests that might be coming up -- ~~beyond that,~~ even out beyond 1990 and 1991; on a one-by-one or case-by-case basis. The ~~and~~ first issue is to ~~of all,~~ determine whether or not they are treaty-compliant and then, secondly, ask ourselves the question, should we modify the test in some way, shape or form so that it can be treaty-compliant?

There is always the possibility of doing that. I have a treaty expert here with me today, but I don't know if it is useful to try to get into what specific tests may or may not be treaty-compliant out in the future. Until you really learn the real details of each test, you can't tell.

Like I say, we have already cleared some 25 or 30 tests.

Mr. DELLUMS. Thank you, General. I just have one additional question, but I would like to make one comment to my colleagues.

It is fascinating that a number of our colleagues who have

said, ''I oppose any abrogation of the ABM Treaty, but let's go forward''--it seems to me that that position is a contradictory position; that is you support ABM, that SDI conceptually violates the logic of ABM and you can't stand in that camp, it seems to me, for long.

My last question goes to the ALPS program, General, the accidental launch protection system that some people are talking about, and this is my final question and then I would yield to my colleagues and maybe come back later for some follow-on questions.

There has been some interest expressed in support of some type of accidental launch protection system program. Some version of ALPS are supposedly propagandized as treaty-compliant, or at least the PR is that, that some type of ALPS program would be ''treaty-compliant.'' My understanding of the ABM Treaty is that territorial defense is explicitly prohibited by the ABM Treaty and that regardless of their being compliant with the ABM Treaty in terms of the number of launches, 100--and you and I talked about this briefly informally this morning--and numbers of launching sites, for example, one, that any ALPS system to be meaningful would have to provide territorial defense and would, therefore, by necessity, have to violate the ABM Treaty.

Can you comment to that, please?

General MONAHAN. First of all, I do know that deploying an additional 100 interceptors is, indeed, permissible. Let me check one other thing.

May I let Lieutenant Colonel George Ash respond? ~~to the territorial--~~

Mr. DELLUMS. We agree on the 100 and the one site. The main thrust of my question is that if the treaty specifically prohibits territorial defense--if you are going to have a competent accidental launch program, don't you then, by necessity, have to violate the treaty?

Lieutenant Colonel ASH. Sir, I don't know that I can give you a categorical answer. The ABM Treaty does prohibit territorial defenses in Article 1, but the question of how much of an area that you defend has to do with what the mission of the ALPS, as you understand it and define it to be. As the General said, Article 3 allows you to deploy up to 100 interceptors to defend a particular area, based upon the sensors and the types of interceptors that you deploy.

But I don't think there is a position that an interceptor that has a very large footprint is noncompliant with the ABM Treaty. That decision just has not been made.

Mr. DELLUMS. I see.

Thank you very much.

The Chair would like to thank my colleagues for their indulgence. I think these are some basic questions that

hopefully will clarify, at least in part, the debate as we go forward.

The Chair now recognizes the gentleman from Arizona, Mr. Kyl, for such time as he may consume, to be followed by Mr. Dickinson and Mr. Foglietta.

Mr. KYL. Thank you, Mr. Chairman.

General, let me ask you some questions first about the flight experiment, which was, of course, one of the key aspects of last year's authorization debate and one of the reasons that the president vetoed the authorization bill.

From what you testified to earlier in response to Mr. Dickinson's questions--and incidentally, Bill, I neglected to see you there. I should defer to you, particularly since this was your question--all right, let me just continue, then, onto your question.

Because of the decisions early in our fiscal year debates, do I gather that decisions were made at that point which set an irrevocable course of action which precluded you, then, from rehabilitating the program after it was reinstated? Is that correct?

General MONAHAN. That is more or less correct, whether or not irrevocable is, indeed--

Mr. KYL. Well, irrevocable to have the tests conducted in December of this year, in any event?

General MONAHAN. Right.

Mr. KYL. My understanding is that, notwithstanding the fact that by the time the bill was signed by the president, that nevertheless the program is--the flights tests are still on hold, that the Air Force has recommended that they go forward, but SDIO has not yet signed off on that.

Do you know whether I am correct?

General MONAHAN. I could probably give you a much more definitive answer, Mr. Kyl, for the record, if I am able, if you would allow that, but we are planning for SBI tests downstream and I think it is the 1993-1994 timeframe. I believe that there just wasn't sufficient funding, as I understand it, left over finally this year.

[Indicating to BG Schnelzer]

Do you want to describe it more? Brigadier General Schnelzer was there during this and I was not. Perhaps he can give a more definitive answer.

Mr. KYL. We would appreciate that, thank you.

General SCHNELZER. If you go back to the cap of 85 million, that was a reduction of 75 percent. It went down to four times less than what we had. Of course, ~~we~~ also, ~~in~~ the 1988 appropriation ~~be~~came in the second quarter of the fiscal year. It was about a 30 percent reduction.

If you combine those two factors, it had a tremendous impact on the SBI program.

Mr. KYL. Excuse me, let's just be real clear on that. The debate that occurred approximately one year ago in the

House of Representatives and the fact that the program--although it passed out of the full committee intact, was reduced by the time it finished floor action. That action alone was enough to stop the program, despite the fact that by the end of the year, and prior to the beginning of the fiscal year, it had been reinstated.

General SCHNELZER. That is correct, Congressman.

Mr. KYL. So that does demonstrate that our actions at this time of the year can have a very devastating impact on your planning.

General SCHNELZER. Tremendous. In fact, we took a 30 percent reduction in the total budget essentially given to us in January when the appropriation was made. If you combine a 30 percent reduction of that magnitude and combine restrictive language, what is forthcoming has a decided effect.

Mr. KYL. Now, to make the point, therefore, what we authorized--and when the chairman talks about the necessary reductions from the Reagan budget--we are talking about actual tests, actual time lags and significant holes in the information that is required for further evaluation. But now to my question. What is the status of that now? You could put that back in the budget; you could conduct the experiments a year late, in December of 1990. Isn't that pretty critical for determination of where we go from here

with SBI?

General SCHNELZER. Yes, sir. We tried to recover as best we could. As you know, with the passage of the bill, the first of this fiscal year, we endeavored to increase that amount of money from $85 million as much as we could and keep the integrity of the program intact. Our report to you in October, if I remember, was around 230 million, 240 million, if I remember correctly. That was our estimate of what we thought we could put back into the program. We have not quite reached that, but we have increased the amount of money for SBI by over 2.3 times over the $85 million cap. That is in the recovery.

Our agent in this case, the Air Force, had to essentially start over in some regards ~~in terms of~~ with a new profile what made sense and they are looking at test flights in the 1993-1994 timeframe.

Mr. KYL. How can you reach the information for the DAB Milestone 2 evaluation in the 1993-1994 framework if you don't conduct those tests in 1990?

General SCHNELZER. Sir, I think the perception ~~we kind of misled by the fact~~ that there is one significant test is misleading. There are a whole series of tests. I will give you an example.

This past year, we had a very key milestone take place at Edwards Air Force Base. We took the motor itself and conducted a test that showed that it, indeed, could provide

the necessary motion as guided by its navigational unit. That took place this year.

This spring, we will have another key test. They will actually have a sensor in front looking out of this test chamber where you actually tie the whole device together from the point of the sensor looking at a target to controlling its motors. That is a key test.

There are a whole series of tests that evolve up to what we call, I guess, the very large flight test that would take place in the 1993-1994 timeframe. But those are very definitely incremental.

The star flight that we have coming up~~, pending very, very quickly,~~ carries the kinds of sensors that would be appropriate to investigate how a space-based interceptor sensor would work. That data is extremely important. So what we have done with--in fact, as the chairman said, with our yearly reductions of 30 percent, we have kept intact what we think is a viable program, a balanced program, reflecting that vital engineering and technical data that allows us to make, I think, reasonable engineering decisions on what a space-based interceptor is.

Mr. KYL. This particular flight experiment was represented to us as treaty-compliant, and my understanding is that it still would be. So the total time for slippage of this program, then, would be how many years?

General MONAHAN. I don't know that you could really measure it in terms of years. As General Schnelzer said, there are an awful lot of test events that are still going on, that are still scheduled to go on.

Out of the original request of 330 million, you know, there is about 130 million lost, so that just called for a very substantial restructuring of the program. Whether or not anyone could accurately reconstruct to the point of saying, how much did you lose time-wise, I don't really know. We are now looking at a revision of the program again and concentrating more of our effort there rather than what went on.

Mr. KYL. I guess it is not as important to establish a specific time that has been lost here as to establish the principle that our playing around with the funding and decreasing it from the requested amount has had a significant impact in delaying the program.

Mr. DELLUMS. Would the gentleman from Arizona yield to the Chair for a moment?

Mr. KYL. Certainly would.

Mr. DELLUMS. I appreciate the thrust of the gentleman's questions, but it seems to me they can be turned around.

The Chair's question is this: What curve are they using to plan? If, over several years, the Congress has been consistent in making cuts in the range of 20- to 30 percent,

then it is one thing for them to plan on the curve of that consistency. That, it seems to me, one could argue might produce an efficient viable program. But if they continue to plan on a higher curve consistently year in and year out, then it seems to me very difficult to rationally argue that you can have a viable program planned out if that plan is always 30 percent above the reality and that is being done several years in succession.

That was the thrust of the opening remarks of the Chair, so I would turn it around. While I think the thrust of the gentleman's questions put the burden of efficiency on the Congress, the Congress has spoken and it has done so consistently for about six years in the 20- to 30 percent range.

So should the other guys get the message that maybe we ought to plan on that curve, as opposed to this unrealistic ''I am going to ask them in the 5 billion range and plan a program that they can't carry out because the Congress consistently doesn't give them those kinds of funds.'' That is the question of the Chair.

Mr. KYL. Was that a question or a statement, Mr. Chairman. I don't know whether the witness--

Mr. DELLUMS. I think the General understands the thrust of my question. I mean, the question that I am asking is can you really say to the Congress that we are developing a

viable plan when you consistently plan 20- to 30 percent higher than the Congress is willing to give you and you do that over several years?

Mr. MCCURDY. Would the gentleman yield?

Mr. KYL. I will as soon as I make a brief statement.

You see, the point, Mr. Chairman, of my comment was that the Congress came back, in its wisdom, following the president's veto of the authorization bill, and restored the funding, but by then--so we didn't cut that particular $230-some million, and yet, because of the actions--the machinations that we went through, their program was totally thrown off stride there. The program was, in fact--that test was, in fact, canceled and now, instead of just having the test a year later, they have gone back to try to put it together in a little different way, as I have heard it described, to conduct some other kinds of tests and perhaps this test, then, might not be conducted for another three years.

Is that correct, General?

General MONAHAN. That is right.

Mr. KYL. Excuse me, Mr. McCurdy.

Mr. MCCURDY. I just wanted to ask--really, on the same note, and that is, another way of doing it is how well can you--what trend or path can you continue if Congress does under-fund, based on your request, and realizing that there

is a consistent pattern in that under-funding? Some of us who have supported higher funding realize quite frankly it is probably not going to continue as long as the goals appear to be loftier than that which Congress is willing to support.

But if you were to go on an ALPS system or something else, do you have some alternative funding profiles that you are not telling us or do you continue, as Secretary Weinberger did for a few years, always come in high expecting to get low? I mean, you are either being grossly under-funded and--or you are overly optimistic or you have something you are not telling us.

Where are we?

General MONAHAN. Let me try to take that, Mr. McCurdy.

First of all, when a budget comes over here, along with that is five-year defense plan. What you see are at least the first two years of it, and by the way, someone in my position--the thing he would like to have would be five years' worth of funding or even more than that tied up.

In some countries they do it that way, you know. They vote the funding for the project, for the entire project, over a period of several years and then they stick with it. That is the prevent the ups and downs and ups and downs and funding instability associated with the program.

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So every time we send over a president's budget, we at least have programmed out what the program is for five years, and as you know, the president has submitted a budget this year that is to cover two years. That is at least a help, if not all five or six--what I would like to see--but at least it is the first two.

So every time it gets changed--by changed, I mean ~~when~~ the amount finally authorized and appropriated ~~in,~~ is indeed, different from that requested, then that, of course, upsets the plan, the five-year plan, and you have to go back and redo it and regroup. That occurs--with the SDI program, of course, it has occurred with some regularity. It occurs in other programs once in a while also.

So if I had my druthers, I would like to see ~~a long--~~ a much longer period of time that I could count on in pursuit of a program.

Now, the next point, in the strategic review that is ongoing--obviously, in the strategic review, we are not looking at just the short-term; we are looking at the longer term, and we are looking at at least a five-year period, and indeed, even making some projections out beyond that.

So what will emerge from the strategic review will be a plan for all of our strategic programs, as well as the

strategic defense Initative, and that will be the next plan. Budgets will be based on that; budgets will be put together on that. To the extent those budgets aren't supported, then, obviously, that will put instability into the plan or make us go back and replan.

Mr. MCCURDY. If I can just clarify that a little more--and I wasn't trying to pose it as an impossible question, but--

Mr. DELLUMS. Does the gentleman from Arizona continue to yield?

Mr. KYL. Yes, I do.

Mr. MCCURDY. Just on one point, and I appreciate the gentleman yielding.

In May of 1988, the Defense Science Board made a recommendation that you separate--that you go ahead and that you go forward with the surveillance system, in addition to a separate track, but I think they realized that, one, the funding and the planning curve were not going together. So they said, let's separate and go ahead and do the surveillance track and have that as a separate course.

Is that not a higher realization of the dynamics of whether it is Congress under-funding or--you know, whatever the realities are--but they realized that that is the first thing that you ought to go ahead and do and that--to continue to have a phase 1 as a total concept is unrealistic to date?

General MONAHAN. I don't know if that is really so, Mr.

McCurdy.

First of all, in phase 1, as I showed, the things that come first are the sensors. BSTS is the first to enter full-scale development, followed by the other items there, and what comes last, as I recall, are the space-based interceptors.

So phase 1 is more or less designed to do just that, but I mentioned also that the phase 1 response to a Joint Chiefs of Staff requirement--the Joint Chiefs of Staff requirement went further than just saying we need to see things; it also says we need to destroy ballistic missiles that would be incoming and so phase 1, then, is designed to respond to that requirement. Therefore, phase 1 needs to have the interceptors associated with them, as well as the sensors.

I think that the phase 1, as approved by the Defense Acquisition Board, didn't go quite so far in doing sensors first and then interceptors. It really kept them a little bit closer together than that original proposal, but nevertheless, the sensors still do come earlier.

Mr. DELLUMS. Does the gentleman yield back his time at this point?

Mr. KYL. Yes, Mr. Chairman. I had intended to yield to my colleague, Mr. Dickinson.

Mr. DELLUMS. Okay. Thank you.

The Chair would like to indicate to my colleague that,

time permitting, we will get back to the gentleman. I know he has a number of additional questions.

The Chair would now recognize Mr. Dickinson for such time as he may consume.

Mr. DICKINSON. Thank you, Mr. Chairman.

Not to belabor the point, but to paraphrase what I understood your agreement with the questions posed by my colleague from Arizona, we protected, in the final conference, the money that has been spent in the bill and which some of us knew was wreaking havoc with the total program and in conference, we--after the veto and reporting of the new bill--we unfenced it and directed that nobody--none of these major programs--there were four, as I recall, take a disproportionate hit or cut.

Now, you are saying that there was a disproportionate hit on the program, but that this has been caused by the turbulence in the program or reduction of the program before so that you had had to cancel and then lay off people and you couldn't regenerate it.

Am I saying substantially what I understood the case to be?

General MONAHAN. That is substantially correct, yes, sir.

Mr. DICKINSON. So the mischief was done before the veto was enacted and--

General MONAHAN. Absolutely.

Mr. DICKINSON. --before we--okay. So at least we tried, some of us did anyway.

Let me get back to the point that--a very telling point, that my chairman raised with you, dealing with the ABM Treaty and the SALT I, SALT II. I think you agree, and I agree, that at some point, there has to be a resolution of do we go forward with the SALT II or SALT III; are we, in fact, headed on a collision course where it would be violated?

You have said yes, at some point, if we continue everything that we have on the drawing board, that we will probably violate the--they will abrogate the treaty, even though we don't have a treaty. But on the opposite coin, we know, in fact, that the Soviets have a substantial effort ongoing also.

Is this correct or not?

General MONAHAN. The Soviets have a deployed ABM system.

Mr. DICKINSON. Well, aside from the system, within--that is the 100 Gulash around Moscow. But we also know they have a rather robust SDI-type program ongoing also, do we not?

General MONAHAN. We know they have some research efforts under way, yes.

Mr. DICKINSON. That is a pretty weak answer from what I understand.

General MONAHAN. Beyond that, Mr. Dickinson, I think I do

start to get classified.

Mr. DICKINSON. Maybe we ought to flush the room and get the facts. The fact is, as I understand it, that the Soviets and us, the United States, are probably paralleling each other's efforts pretty substantially. Maybe we are going in some directions differently, but at some point, they are going to be faced with the same choice that we are. They have a robust R&D effort dealing with the types of programs that we are dealing with and if we sit on our hands because we say, ''Well, we can't do anything because we might run afoul of the treaty,'' then we will, in fact, be in the soup, so to speak, because the Soviets--they are progressing apace with us, as far as we know. We have reason to believe that is true and that--these are my words, not yours, and you can confirm or deny that in a classified session, but the point being, if we don't go up to that point and then have a resolution on whether or not there will be a new SALT, then the Soviets will have no reason to enter into a new SALT. They will have that capability. We will not have developed anything to entice them to come and negotiate a new treaty and so we will have dealt ourselves out of the game completely.

Would you agree with that?

General MONAHAN. We can do an awful lot technically under the treaty as it is today. If I gave an impression that I

can't do this unless you change the treaty, that is entirely wrong. I mean, we can and should do an awful lot of work here.

Mr. DICKINSON. I am not making myself clear. The chairman said, and I agree with him, that if we proceed along the lines that have been laid out for SDI, and go forward with the plans, at some point, we will run up against the treaty and have to make a decision to abrogate it or not; is that right?

General MONAHAN. Yes. Yes, sir.

Mr. DICKINSON. Okay. So we are not planning to abrogate the treaty at this point until at least we know that the Soviets are. If we don't go forward with our research and development efforts up to that point, then there is no reason to ever think that the Soviets would enter into another treaty because there is no reason to, where they have the capability and we don't.

Would you agree with that?

General MONAHAN. I would say that is indeed possible. I am not an expert on arms control, Mr. Dickinson, but it strikes me that what you say is--

Mr. DICKINSON. I am really asking you about the tenor and the tone and the direction of our development, research and development efforts. We know where they are going and we know at some point we have to either renegotiate with the

Soviets or else we will both abrogate and go forward.

Let me ask you a little more mundane question. We know that in order for a ground-based laser to be effective that you have to deploy satellites and mirrors to deflect and reflect the laser beam itself. The biggest problem--or one of the biggest problems is going through the atmosphere. Am I right so far?

General MONAHAN. Yes, indeed.

Mr. DICKINSON. Okay. Does it make sense, is it practical and are we experimenting with the concept of putting such a power system on an aircraft that could take it up through most of the atmosphere? Is that reasonable? Or have we discounted that?

General MONAHAN. I would have to ask--you know, we used to have an airborne laser laboratory and we finally grounded it. Maybe those are the reasons why. You would have to get an awful lot of power onboard that airplane and the big problem with doing that is power on airplanes.

Mr. DICKINSON. I know that is a problem, but it also reduces the requirement the higher you get, so the question is, do we have an ongoing experiment--have we tried that and discarded it as not practical?

General MONAHAN. ~~Mr.~~ Dr. Mike Griffin, our technology expert--

Mr. DICKINSON. Okay.

~~Mr.~~ Dr. GRIFFIN. Just to comment very briefly, the main

problem in putting a laser such as you describe on an airplane in place of the ground-based free-electron laser or other laser concept would be the power source required on the airplane. Now, we are looking at--you didn't ask this question, but we are looking at space-based applications of that laser. That is in a follow-on timeframe to the current GB FEL work that is ongoing in the technology directorate.

But for airplane use, we don't see the availability of a compact power source at this time.

Mr. DICKINSON. Even though the higher you get, the less energy it would require--you still wouldn't have enough to--

~~Mr.~~ Dr. GRIFFIN. That eases the atmospheric compensation problem, but it does not alter the requirement for laser brightness to a significant degree. That is a power issue.

Mr. DICKINSON. So, for that reason, we would go to space-based laser, rather than try to develop some aircraft that would do that?

~~Mr.~~ Dr. GRIFFIN. That would be the thinking at this time. If there is a breakthrough in compact energy storage or something of that nature, then it would be time to reevaluate.

Mr. DICKINSON. In closing, Mr. Chairman, and I don't want to monopolize all the time, it is my recollection that the ABM Treaty that was agreed to was put in place based on the concept--on the logic that we would put this SALT treaty in

place and then that we would have a reduction in offensive weapons. Then we observe that for whatever the period was, seven years, and then we negotiate a SALT II, which was not ratified, but since then, we have not seen the reduction in weapons that the first and second treaty envisioned--did envision.

So it was not ratified and so you can't--we can't always be held to that since--when the first treaty was put in place, we didn't have a concept of SDI, and so all this has been as a result of developments since; technologies have been recently developed; they were never envisioned when the treaty was put in place.

So at some point, we have to make another determination: Do we want a new treaty with the Soviets and then what will that treaty encompass and will the Soviets then come to the table based on the fact that they are assured that we have a capability also or will they say, ''Who are you kidding; you don't have any effort going worth mentioning and we have a robust system and we don't need a treaty?''

Thank you, I yield back.

Mr. DELLUMS. The gentleman yields back his time.

Mr. Foglietta is recognized for such time as he may consume.

Mr. FOGLIETTA. I thank you, Mr. Chairman.

General Monahan, in 1983, I remember attending a breakfast

at which the speaker was Dr. Edward Teller, and he conceptualized what he believed could be the development of the SDI program.

Today, except for the reduction of sophistication of some of those concepts into sketches, and as I see the reduction in size and the expansion and efficiency of some component parts, and after the expenditure of some $14.7 billion, I don't see much of a development from the concepts expressed by Dr. Teller six years ago.

Is that because this is an unclassified, open hearing and would it be different if it was a closed hearing?

General MONAHAN. I don't believe that that would make a substantial difference, whether or not we were closed, in that particular point. I think what you are finding is that the program is getting now to the stage where you are going to see an awful lot more in the way of hardware that has been developed and is now in an experimental stage.

I am just trying to--somewhere in here I think I have a list of all the tests that we plan for the next two years and it is, indeed, this long, and there will be substantial. For example, we will have a beam experiment aboard rocket here just next month and there are quite a few. Here is an entire list of them right here and I could furnish these to you.

Also, in the Report to Congress which we submitted--the

classified version in January and then the unclassified version just today--you will find these laid out. I think that would give you a better indication of just where we are.

Mr. FOGLIETTA. Have we advanced--or to what extent have we advanced in the development of these technologies that we heard about six years ago?

General MONAHAN. We have advanced to the extent that we ~~have decided to~~ (first of all), ~~we~~ are able to finally coalesce them down into the various elements that I showed today, and it takes advancing technology to get them down to figure out, yes, indeed, this is the way now that it ought to be packaged, and know that you have a very good chance that they will work.

Then, having done that, now we have taken them into the next stage of development, which is just short of full-stage development. We call it the demonstration and validation phase. So all of those elements in the phase 1 system are in that phase today, except for the ground-based radar, which is just about to enter DEM/VAL.

That says that you have advanced the technology far enough so now you are at the point of being able to test a certain amount of hardware and now you can start narrowing down your specifications so that in a couple of years, when you get to the full-scale development phase, you are up and you are

ready to go.

In the spending, you know, spending has been--by comparison, has been like this at the present time and when you get into full-scale development, then it would rise further.

Mr. FOGLIETTA. I also see a book that was distributed here promoting the SDI technology transfer to the United States public and private sectors. Suppose we had diverted the $14.7 billion over the last five or six years to commercial research. Do you think that would have been advisable?

General MONAHAN. The president established the SDI program--first of all, what he did was, in establishing the SDI program, we brought together--many technology efforts that were under way out there, but they were fragmented, and they weren't integrated properly. So an awful lot of what you see here and what SDI has done for the past five years is effort that was already on the books and people had already planned to do.

I think you are into some very key technology areas here, as Mr. Dickinson mentioned. The Soviets aren't stopping out there. There is no question about that, although I can't get into details with you, but they are looking at it very, very robustly, at a lot of areas of technology. So, if we don't, we do so at some great peril.

I think that the money has been, indeed, very, very well spent, even if you went no further in the program. I don't advocate that, but that is the case.

Mr. FOGLIETTA. I thank you, General.

I yield back the balance of my time.

Mr. DELLUMS. The gentleman yields back his time.

Mr. McCurdy is now recognized for such time as he may consume.

Mr. MCCURDY. Thank you, Mr. Chairman.

General, since you have taken over in February--we understand that there is always somewhat of a transition and a learning curve and that is occurring at the same time we have a new administration with a transition.

I am curious, since we have been addressing this over the past five years, how much change there has been in SDIO. How many personnel are within the organization at this point?

General MONAHAN. In the organization, in the Pentagon, about 260 people.

Mr. MCCURDY. Two hundred and sixty?

General MONAHAN. Two hundred and sixty, yes, sir.

Mr. MCCURDY. What percentage of turnover would they have had in that group? Have you had high turnover of scientists? Have you have had a fairly constant group there?

General MONAHAN. I haven't been there long enough to note, to tell you truth.

Mr. MCCURDY. Do any of your briefcase carriers back there have any?

General MONAHAN. They might, but I don't think it is been inordinate one way or the other. I will tell you this, if you can find any better scientists and engineers somewhere, in government or in industry, be my guest. They really are an excellent crew.

Mr. MCCURDY. I was curious--I am not trying to be sarcastic; I am curious whether or not you had difficulty attracting, and if so, is it an issue of how much you can pay, the degree of challenge, the science, the love of the challenge itself? It really goes to these--you know, the young technician that you had come up there--are you having a hard time recruiting people like this or do they come, stay a year and go off to Lockheed or somebody at three times the salary? What is the--

General MONAHAN. I don't think the program has enough experience just yet to know whether or not enough people would turn over and move on out to jobs in industry. Because of the nature of this program, I think we are a magnet for very bright people, and I think that is probably what sets SDI apart from other programs. I think in other areas within the government, we clearly do have a lot of

difficulty attracting the kind of scientific and engineering people that we need to have.

Mr. MCCURDY. DARPA, for instance, testified a few weeks ago that they actually have a policy of having turnovers. Again, I am just curious about the philosophy within SDIO as far as the type of people you want to attract, how long do you want to keep them and are you having difficulty, and if you could, if you have a personnel manager or someone over there, would you furnish that to us?

General MONAHAN. I would be very happy to do so. I will be able to give you more.

[The information follows:]

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| HEARING DATE 14 MARCH 1989 | TRANSCRIPT PAGE NO. 66 | | LINE NO. 1594 | | INSERT NO. | | | |

QUESTION: DARPA, for instance, testified a few weeks ago that they actually have a policy of having turnovers. Again, I am curious about the philosophy within SDIO as far as the type of people you want to attract, how long do you want to keep them and are you having difficulty, and if you could, if you a personnel manager or someone over there, would you furnish that to us.

ANSWER: SDIO has no formal policy established on having turnovers. Our turnover rate, I feel is low, and is generally caused by the routine turnover of the military officers and enlisted personnel currently assigned to SDIO. Our civilian workforce, in my opinion, is very stable. Our secretarial workforce is our largest area of turnovers and is typical of the clerical workforce in the Federal Government today.

We seek highly specialized individuals, be it military or civilian personnel. This is primarily a direct result of the mission of the SDIO. Due to the extensive research and development required to have an Strategic Defense, we must attract individuals whose background is extensively involved with the various technologies that we require, i.e. DEW.

The SDIO has a Chief of Staff whose responsibility includes the manpower, personnel issue. In addition, we have a Resource Management Directorate which includes a Human Resources Division. Our personnel office serves as liaison personnel office, not an operating one, and we receive support in these areas from Washington Headquarters Services.

General MONAHAN. I will tell you this, I want to attract the very best people we can. I think we have been fortunate because the nature of the program is a real magnet and I would like to keep them just as long as we possibly can. We might move them around within the organization--

Mr. MCCURDY. Has SDIO taken the approach, say, of DARPA, as opposed to strictly program managing or programs such as the F-16, where you have actual large numbers of people? Are you more just managers just going out and saying, ''Well, here's the areas we want to go contract in. We let contract and we supervise those contracts.'' Is there a difference in philosophy--

General MONAHAN. There is ~~a~~ within our Organization ~~right~~ ~~with~~in the Pentagon ~~in the SDIO itself~~, there is a mix of management-type people and scientific and engineering people. We are just the tip of the iceberg. Right now, we estimate 30- to 33,000 people in this country are working on the SDI program.

In fact, I have some additional data about that. I would be happy to provide it to you, but we are just the start. You know, an awful lot of the work we do is performed by the Army and the Air Force, some by the Navy, DARPA, Department of Energy, et cetera. We get just excellent work from the national laboratories under the Department of Energy.

Then we do a fair amount of it ourselves. Obviously, the

responsibility to integrate all of those various elements that I briefed you on--that can rest nowhere other than within the SDI organization itself, so because of that, we need managers, scientists and engineers.

Mr. MCCURDY. That is why I am interested in your delta there, the percentage of change, where you have had--

General MONAHAN. Okay, we will try to get that information for you.

Mr. MCCURDY. Let's focus on cost for just a minute. I was fascinated by the chart in your briefing that shows the curve coming down on the cost. I only wish we had other program managers who came before us on this committee with similar experience. Most every program we have had thus far has actually had a learning curve going the other direction. Maybe we ought to take these 260 people and put them elsewhere in the department because the--I don't care if it is a system that I strongly supported, such as the C-17, which seems to have some cost growth, which is just a transport, or whether it is an ATF or an ATA or just even simple missile systems--that is on page 27, I finally found it.

The cost you indicate from 1988, from the DAB review there, to--from June 1988 to September 1988--you are forecasting, because of technology developments, a reduction of some $40 billion and your cost goal is the further

reduction of almost another 15 to 20 billion. How are you able to accomplish this?

General MONAHAN. Okay. Let me take the first part of how it came down here to the 69 billion from what it had been before. Technology development was part of it; another part of it was de-scoping, a good portion of the program, not ~~as~~ just many of the interceptors. Recall that phase 1 is built to fulfill a JCS requirement. The requirement is classified, but nevertheless, it is designed to do that. They found they didn't need quite as much in the way of fielded hardware to fulfill that requirement and that is one of the major reasons why it was reduced down to 69 billion.

There also was--because the technology is moving kind of fast--a determination that certain of the hardware could really do more than originally planned. So that is how it got down there to the 69 billion.

Mr. MCCURDY. So it is not technology development, per se, it is a change in the requirements.

General MONAHAN. It is both. It is both.

Mr. MCCURDY. Tell me a little more about the technology development. You told me about the change in requirements. What significant breakthrough has there been that allows that cost reduction?

General MONAHAN. I don't know that there was a real significant breakthrough. Let me just check.

Okay. Certain functions that were duplicated on certain elements of the program, ~~they didn't--~~they removed the duplication. For example, certain things that SBI was doing, the SSTS was already doing. They took some of that function away from the SBI; therefore, brought that cost down. I don't think you can call that technology development, so I don't think I answered your question yet. We need to take that for the record.

Mr. MCCURDY. I would be interested to see that.

[The information follows:]

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Enclosed is Lt Gen Monahan's testimony ations.
Legislation and National Security, Com es
Attached to the testimony is an SDIO in from
detailed discussion on the reasons for th
June 1988 ($115B-88) to October 1988

STATEMENT ON

# THE STRATEGIC DEFENSE INITIATIVE

BY

LIEUTENANT GENERAL GEORGE L. MONAHAN
DIRECTOR
STRATEGIC DEFENSE INITIATIVE ORGANIZATION

BEFORE THE

SUBCOMMITTEE ON LEGISLATION AND NATIONAL SECURITY
COMMITTEE ON GOVERNMENT OPERATIONS
HOUSE OF REPRESENTATIVES

101st CONGRESS, FIRST SESSION

MARCH 21, 1989

Mr. Chairman, your letter of invitation asked me to testify before the Subcommittee on Legislation and National Security, on the subject of cost estimating methodologies and the basis for the cost estimates for the potential Phase One Strategic Defense System (SDS).

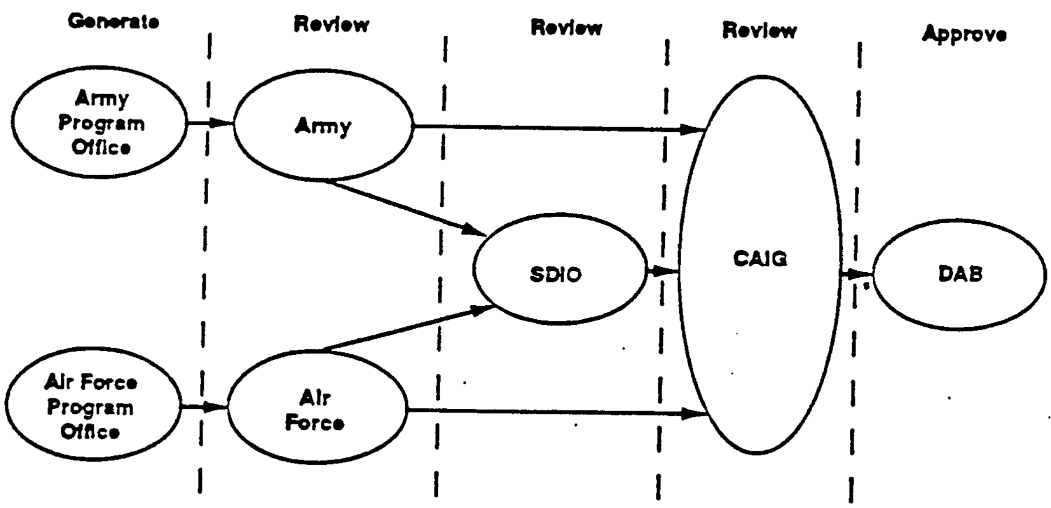
Cost reduction has long been recognized as an important component of the SDI program, and cost-reduction efforts have been emphasized in tandem with technology research. By anticipating potential SDS costs, and by implementing technology development strategies that focus on reducing costs, we believe we are focusing directly on one of the key issues of SDI, affordability. As Lieutenant General Abrahamson testified last October to the joint committees on Armed Services, the current estimate of the total cost to demonstrate, validate, develop, produce and deploy the first phase of an SDS is $69 billion in constant FY 1988 dollars (B-88). This figure is a substantial cost reduction from the $115 B-88 estimate of June 1988, and we expect even further reductions as architecture refinements and other improvements are made. The reduction to $69 B-88 was achieved largely through eliminating unnecessary redundancy from the SDS architecture and operational concept, increasing space-based interceptor performance, and reallocating interceptors from space to ground.

I think it is important to note that the majority of our cost estimates are the product of current Army and Air Force cost estimating methods and processes used for <u>all</u> weapon systems.

These Service cost analyses are based on the actual cost histories of existing systems and projections of the impacts of new technologies and processes. Chart 1 illustrates the process by which the $69 B-88 cost estimate was reached. A final review is conducted by the Cost Analysis Improvement Group (CAIG), before presentation to the Defense Acquisition Board.

Chart 1

## THE SDS COSTING PROCESS




I have attached to my statement an unclassified information paper detailing how SDIO arrived at the $69 B-88 cost estimate. I think you will agree with our conclusion that the cost reduction achieved last year was a result of finding a better way to do the job, not simply "improving" the cost analysis procedures.

SDIO will continue to sponsor research that will aim at reducing both the costs of systems due to performance requirements and the costs of systems due to administrative and regulatory requirements, and continue to emphasize the importance of how much a system "could cost." Our goals are a properly balanced architecture that allocates functions in the most economical way, and an industry that efficiently adds value to its products using the most appropriate technology and capital base. SDIO will continue to set challenging cost objectives, and will continue intensive efforts at cost reduction.

While we have estimated the cost of Phase I to be $69 B-88, we are reviewing alternative architectures and technologies that could result in the cost estimate being substantially reduced from $69 B-88. Phase I has just entered the Demonstration and Validation phase; it is at a very early stage in the acquisition process and cost estimates can change. We anticipate achieving cost goals and bringing the total cost of Phase I below $69 B-88.

I am prepared to address your questions.

- Information Paper -

# STRATEGIC DEFENSE SYSTEM COST REDUCTION June 1988 to October 1988

March 21, 1989

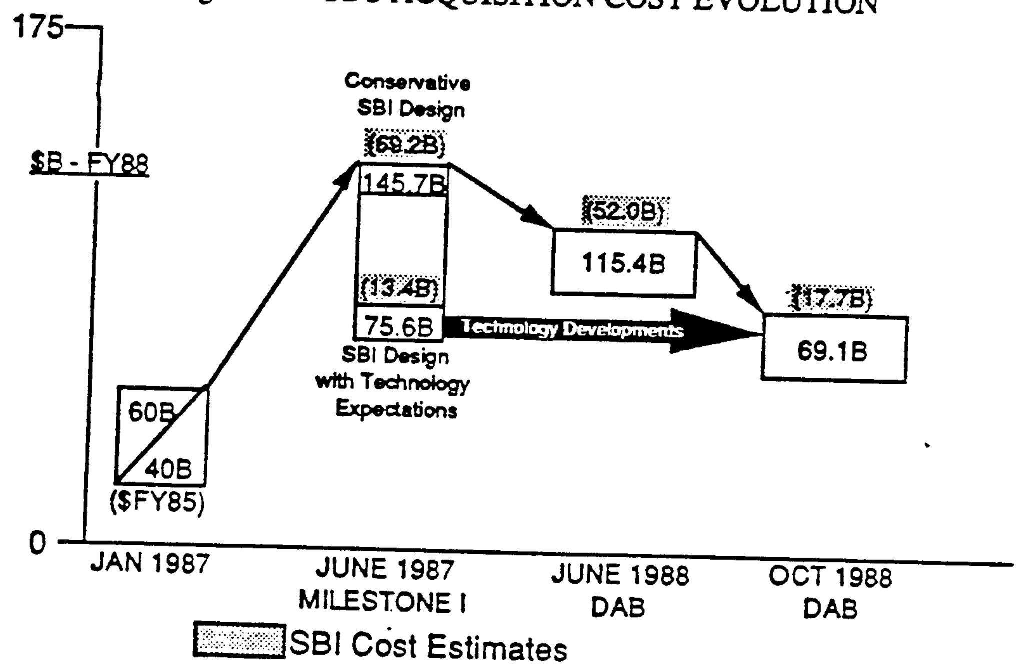
*Phase I of the Strategic Defense System is currently in the Demonstration/Validation phase of system acquisition. As such, it is undergoing research, development and testing aimed at developing an optimal system to enter Full Scale Development. SDS Phase I is a "system of systems" in that its major elements (see following) are systems in their own right. The overall costs of SDS Phase I depends on the functions assigned to each of these elements, the degree to which these functions must be assigned to more than one element to bolster confidence, and the projected availability of key technologies. In the process of developing SDS Phase I, significant improvements have been realized in the cost to perform its mission. This paper discusses those improvements.*

## I. INTRODUCTION

The latest official DoD (SDIO, Army and Air Force) estimates for the acquisition of the initial phase (Phase I) of the Strategic Defense System (SDS) saw significant refinements and reductions between June and October 1988, dropping from $115 billion to $69 billion in Fiscal 1988 dollars. This resulted from reallocating functions, earlier realization of technology expectations, removing excess performance and continued refinement of the system definition. These reductions were accomplished while maintaining the ability of the system to satisfy its mission requirements and without major changes to cost estimating methods.

The evolution of acquisition cost estimates from the initial cost projections in January 1987 through the Defense Acquisition Board (DAB) Milestone I review and subsequent update reviews is depicted in Figure I-1. The original January 1987 estimates were based on an architecture that was designed for production of a strategic defense system as soon as possible. At Milestone I, as the Joint Chiefs of Staff requirements were established, the costs reflected a more robust architecture to meet those requirements. Note that uncertainties in architecture design requirements at that time resulted in a range of costs corresponding to a range of technical options.

Figure I-1. SDS ACQUISITION COST EVOLUTION



The October 1988 estimate reflected a more mature design and updated technology projections than were used for the June 1988 estimate. The October estimate also reflects more emphasis on ground-based weapons for the initial deployment. The cost of the Space-Based Interceptor (SBI) element is highlighted in this chart because of the dramatic change in its acquisition estimate. From June to October, Space-Based Interceptor (SBI) weapons constellation size decreased by 51% while ground-based Exoatmospheric Reentry Vehicle Interceptor Subsystem (ERIS) weapons increased by 70%. These quantity changes incorporate improved SBI performance and survivability measures, and reduce architecture performance that was previously above the Joint Chiefs of Staff requirements for the Strategic Defense System Phase I. Nevertheless, these tradeoffs were made not only on the basis of reducing costs. The robustness of the mix of SBI and ERIS elements to countermeasure alternatives was an important factor in the October 1988 estimate.

The remaining discussion will present: an overview of cost analysis and estimation techniques used, reasons for the changes in cost, details of the cost reductions, a discussion of system performance, and conclude with SDIO's plans for continuing cost reduction and attainment of cost goals.

## II. COST ANALYSIS

In order to put the cost reduction effort in perspective, an understanding of some basics of cost analysis is required. The 1988 service cost estimates are the product of current Army and Air Force cost estimating methods and processes used for all weapon systems. These Service cost analysis systems are based on the actual cost histories of existing systems and projections of the impacts of new technologies and processes. Further, assessments have been made by all levels of the Service command structures in order to determine whether the work described can be performed within the estimate. The cost reduction observed between June and October of last year was a result of finding a better way to do the job, not by simply "improving" the cost analysis procedures.

Cost estimates are developed in dollars for a given "base year", normally the same fiscal year in which the estimates are generated, representing what a system would cost "today." In actuality, the costs are distributed throughout the life of the system acquisition. Projected inflation rates by year can be applied to the constant year estimates to obtain an escalated estimate, but this estimate would over emphasize later costs (e.g., in production) and not be comparable to the costs of systems acquired in different timeframes.

Cost estimate development uses a combination of three cost estimating methodologies: parametric, analogy, and engineering build-up. Parametric methodology involves the use of Cost Estimating Relationships (CERs) which relate a selected design or performance parameter (e.g., weight, power) and an item's cost. Analogy estimating derives a cost from data on an existing system based on engineering judgement of the effects of complexity, technical, or physical differences. Engineering build-up is applied to items where estimates are attainable at the lowest functional level of detail (e.g., direct labor, tooling, materials).

Design, performance or other technical characteristics that best describe a system are selected to estimate costs and are termed "cost drivers". History and logic have shown that the cost of a system varies in relation to the value of these characteristics. There are many cost drivers, but those that cause the majority of near-term changes in system cost fall into three primary categories: size, complexity and technology.

Size is the most dependable of the three; when other aspects are the same (parts density, manufacturing complexity, product technology, etc.), then the size of an item will directly relate to its cost: bigger houses cost more; 10 pounds of hay costs more than 5 pounds. However, the relationship between cost and size is not necessarily linear. "Economies of scale" can occur which result in the cost-per-unit-size of larger items to be less than that for smaller (the "large economy size" phenomena). Size increases often result in proportionally lower cost increases.

The impact of complexity is illustrated by the comparison of satellite mechanical structure to satellite communication equipment. Satellite structure involves few pieces but is the result of a complex design and production process because it must be as light as possible and adapt to wide ranges of temperature. The complexity of the communication equipment far exceeds that of the structures. The communication equipment material must meet the same weight and temperature requirements as the structure, and be built so that its many parts and connections operate for long periods of time. Products are split into similar complexity level groups for analysis. Therefore, estimating relationships developed for structures yield lower costs than those for communication equipment for like sizes.

The goal of technology development is often to reduce the cost of a function or product. The control of technology and the anticipation of the impact of new technology on system costs are major problems facing our acquisition system today. Available, simplifying technologies bring costs down, while rare and enabling technologies may drive costs up. This requires that the mix of technology in a product be carefully tracked when developing a cost estimate. The SBI Focal Plane Array (FPA) is an example of a technology that is expected to make the transition from expensive to cheap, and the consequent possibility of replacing a scanning array with a staring array is one of the reasons that the estimated costs of SBI could be reduced so dramatically.

In the past, costs of individual units have been observed to decrease in a somewhat predictable manner as the quantity increased. These reductions are attributable to job familiarization by workers performing repetitious tasks, general improvement in tool design and utilization, production control improvements, reduced scrap, improved materials flow, and other factors. "Learning curves" are non-linear equations that are applied to almost all production cost estimates, especially where the units involved justified planning and tooling activities over those used to produce a development, or prototype, unit. The "learning" concept's importance to this discussion is enhanced by the fact that several of the cost increases and decreases of the Phase I elements were directly related to quantity increases and decreases. The non-linearity of learning; however, precludes a one-to-one comparison of the cost change to the quantity change (i.e., a 50% reduction in quantity equates to a less than 50% reduction in cost).

The above discussion provides a brief summary of the analytical issues which are addressed in the cost analysis of modern defense systems. It does not provide a comprehensive review of the topic, but should be of assistance in understanding the cost changes discussed in the following section.

## III. COST REDUCTIONS

Overall the acquisition costs for Phase I SDS between June 1988 and October 1988 declined 40% (Table III-1). Only three of the nine elements had modest cost estimate increases (ERIS, GBR, Launch), while four had major decreases. Of these elements, the one with the most dramatic reduction was the SBI going from $52 billion in June to $17.7 billion in October, a decrease of 66%. It is important to note that a performance reserve is allocated to allow for additional capability expansions if required to meet a changing threat, and that the management reserve ("Cost Reserves") imbedded in the estimate exceeds 10% for both Development and Production phases. This reserve is a key part of stablizing costs in a changing technology and threat environment.

TABLE III-1. ACQUISITION COST REDUCTIONS (FY88$ IN BILLIONS)

| Element | Jun DAB | Service Briefs (Oct 88) | $ Reduction | % Reduction |
|---|---|---|---|---|
| BSTS - Boost Surveillance and Tracking System | 9.0 | 8.0 | (1.0) | (11%) |
| SSTS - Space-Based Surveillance and Tracking System | 12.6 | 9.2 | (3.4) | (27%) |
| GSTS - Ground-Based Survillance and Tracking Systems | 3.6 | 3.3 | (.3) | (8%) |
| SBI - Space-Based Interceptor | 52.0 | 17.7 | (34.3) | (66%) |
| ERIS - Exoatmospheric Reentry Vehicle Interceptor System | 4.8 | 5.8 | +1.0 | +21% |
| BM/C3 - Battle Management/Command, Control and Communication System | 14.6 | 7.3* | (7.3) | (50%) |
| GBR - Ground Based Radar | 2.7 | 3.1 | +.4 | +15% |
| SE & I - System Engineering and Integration | 7.8 | 5.0* | (2.8) | (36%) |
| LAUNCH | 8.3 | 8.6* | +.3 | +4% |
| Cost Reserves (Imbedded) | | [7.6] (DVMT = 10.4%, PRDN = 14.4%) | | |
| Performance Reserves | — | 1.1 | +1.1 | — |
| TOTAL | 115.4 | $69.1 | (46.3) | (40%) |

* SDIO ESTIMATES [] NON ADD

A major factor behind the cost reductions was the evolutionary elimination of redundancy from the SDS architecture and operational concept. An extensive architectural analysis highlighted areas in which overlaps in functions existed unnecessarily between individual elements. Although pre-planned redundancy is a legitimate instrument for reducing risk or increasing survivability, the existence of unplanned redundancy can

increase costs without helping risk or survivability. The other factors behind the cost reductions were technological advances and architectural improvements. Minor changes in cost estimating methodologies were made only in the rare cases where new reference data was available. Table III-2 lists the changes in primary technical cost drivers from June to October as a percentage of the June baseline. Changes in cost relate to the changes in these cost drivers. This can be seen in the following discussion of Phase I elements.

The most substantial portion of the overall SDS cost reduction was due to the 66% reduction in SBI, which was achieved through a combination of several factors:

Communications/Processing: The amount of SBI Communications/Processing equipment has been decreasing. Initially, Communications/Processing in SBI was reduced as technology development allowed more specific selection of components (June 1988 case), and then the BM/C3 function was removed since it was redundant to that on the SSTS. This significant reduction in weight generates a significant reduction in the cost of the current SBI system.

Infrared Sensor: This equipment provided the fire control capability for initial high-cost cases. The June 1988 version of the SBI carrier vehicle had sensor, laser gimbal and structure hardware to perform this function. Further, this equipment increased power, thermal control, structure, reaction control and propulsion requirements of the basic carrier vehicle. By removing the fire control function from the carrier vehicle, the cost of the equipment and the cost of accommodating it was saved. The reduced complexity of the satellite greatly reduces development risk as well.

Quantities: The reduction in quantity of interceptors and carrier vehicles in the current SBI concept significantly reduces the recurring production cost of the SBI element. For example, by reducing the total production quantity by 53%, the recurring production cost for the constellation can be reduced by 49% even if no other changes take place due to simple learning effects.

Carrier Vehicle Weight: This parameter refers to the weight of the carrier vehicle without interceptors, communications, processing or other payloads. Although the weight of the June 1988 and October 1988 designs are nearly the same, the composition changed. The current carrier vehicle has fewer expensive components and more inexpensive components. Elimination of redundancies warranted the removal of the fire control sensor and the $BM/C^3$ functions. These payload deletions along with their associated equipment have reduced requirements on every carrier vehicle subsystem and significantly reduced program risk.

Interceptor: A key SBI driver is the focal plane array (FPA). We are now working toward an improved technology that will be more producible and affordable based on results from recent laboratory accomplishments. The key to these advances is the ability to produce "chips" of the proper material in the proper configuration. These chips improve performance so that a lighter projectile can be produced. The lighter projectile makes it feasible to resize the rocket motors, and thus increase the velocity, range and effectiveness of the interceptor. The increase in motor weight is an extra load on the carrier vehicle structure, but these are very inexpensive components on a weight basis compared to the rest of the system. The estimated cost of the FPA is based on history and progress in technology development.

High Rate Production: The SBI carrier vehicle will be the first satellite to be produced in numbers comparable to aircraft or weapon system production. The simplification of the satellite has reduced the risk of unforeseen problems during the development phase, and it enables us to plan a more economical production program as well.

TABLE III-2. PRIMARY SDS PHASE I COST DRIVER CHANGES

| PARAMETER | % OF JUNE BASELINE | CHANGE RATIONALE |
|---|---|---|
| SBI | | $52.0 B (88) → $17.7B (88) |
| FIRE CONTROL SENSOR | 0% | • REDUNDANT TO OTHER SENSORS |
| INTERCEPTOR WEIGHTS<br>• PROJECTILE<br>• MOTOR STAGES | <br>59%<br>315% | <br>• ENABLES VELOCITY INCREASE/COSTLY<br>• FOR VELOCITY/INEXPENSIVE |
| INTERCEPTOR APERTURE | 70% | • FOCAL PLANE ARRAY TRADE |
| CARRIER VEHICLE WEIGHT<br>• DRY (NO PROPELLANTS)<br>• TOTAL | <br>92%<br>97% | • HEAVIER INTERCEPTOR PAYLOAD, BUT LESS COMPLEX |
| COMMUNICATIONS/ PROCESSING WEIGHT | 30% | • BM/C3 REDUNDANT TO SSTS |
| ELECTRICAL POWER | 25% | • EQUIPMENT REDUCTIONS |
| QUANTITIES<br>• CONSTELLATION<br>• PRODUCTION | <br>49%<br>47% | • WEAPON REALLOCATION<br>• IMPROVED PERFORMANCE<br>• REDUCED PRODUCTION RISK |
| SSTS | | $12.6B (88) → $9.2B (88) |
| APERTURE | 50% | • MISSION REDUCTION<br>• MANAGE SENSOR REDUNDANCY |
| DETECTORS | 10% | • REDUCED APERTURE<br>• MISSION REDUCTION |
| SIGNAL PROCESSING | 13% | • REDUCED DETECTORS |
| DATA PROCESSING | 23% | • REDUCED DETECTORS |
| ELECTRICAL POWER | 43% | • EQUIPMENT REDUCTIONS |
| SATELLITE WEIGHT<br>•DRY (NO PROPELLANTS)<br>•TOTAL | <br>53%<br>87% | • INCLUDES NEW INTEGRAL STAGE<br>• ORBIT INSERTION PROPELLANT |
| QUANTITIES<br>•CONSTELLATION<br>•PRODUCTION | <br>150%<br>157% | • COMMUNICATIONS DRIVEN |
| BSTS | | $9.2B (88) → $8.0B (88) |
| QUANTITIES<br>•CONSTELLATION<br>•PRODUCTION | <br>75%<br>80% | • REDUNDANT SENSOR CAPABILITY |
| ERIS | | $4.8B (88) → $5.8B (88) |
| QUANTITIES<br>•DEPLOYED<br>•PRODUCED | <br>170%<br>163% | • WEAPON REALLOCATION<br>• REDUCED RISK |

Several new technologies have been used to improve the SBI, ranging from improved propulsion to enhanced seeker focal plane materials. However, none of these advances has been achieved spontaneously. They are the result of parallel advanced technology programs that have been seeking better capabilities at lower cost for several years. Current SBI designs take advantage of expected technology developments in which we have high confidence. We anticipate that, as they mature, these and several other technology developments will continue to provide performance augmentation options for the system elements.

The SSTS acquisition cost decreased from $12.6 billion to $9.2 billion. This resulted from the combination of a significant decrease in individual satellite capability and cost, and a relatively smaller increase in constellation size. The net effect is a less expensive system which continues to support architecture sensing and coverage requirements. As with SBI, the opportunity for a reduction in the SSTS sensing capability occurred because of redundancy within the overall architecture. The combined sensing capabilities of GSTS and GBR, as well as the sensor on the ERIS interceptor, allowed reductions in SSTS capabilities without compromising SDS effectiveness. The scaleback of SSTS was accomplished by a 50% reduction in aperture size and the elimination of 90% of the number of the detectors, allowing corresponding reductions in satellite structure, processing, and other subsystems. This combination of effects resulted in the significant decrease in SSTS costs.

BSTS's acquisition cost decreased from $9.0 billion to $8.0 billion between the June and October estimates. The cost reduction resulted from a reduction in constellation size and a technical reassessment of the FPA as described earlier for SBI interceptor cost impacts. Although the change has decreased the sensing capability of the BSTS constellation, the reduction did not lead to a decrease in military effectiveness. Analysis of previous architecture concepts showed there was an excess of sensing capability relative to weapon capability -- the sensors could acquire more information than required. The removal of this "excess" sensing capability reduced costs without a corresponding degradation in overall system effectiveness.

The cost of the ground-based ERIS increased from $4.8 billion to $5.8 billion between June and October, because of a decision to utilize more ground-based interceptors. The increased capability of the space-based interceptors allowed its numbers to be reduced even further than the compensating quantity increase in ERIS without impacting the SDS mission. The increased ERIS cost is due to a 70% increase in interceptor inventory along with parallel increases in launchers, support facilities and personnel. Due to the large amount of non-recurring cost in the estimate, which is independent of quantity, this equates to only a 21% increase in total acquisition cost.

A second SDS element to experience a slight cost increase between the June and October DAB reviews was GBR. The increase, from $2.7 billion to $3.1 billion, resulted from minor programmatic changes relating to schedule, and new cost data received from the contractor for the experimental version of the radar (resulting from the pending expansion of GBR from a terminal only sensor to a midcourse/terminal sensor.) GBR is not currently approved as an element of Phase I. It is under consideration and included here for architecture analysis purposes.

GSTS did not experience any significant technical or programmatic changes. The cost of GSTS declined slightly from $3.6 billion to $3.3 billion, due to a reduction of flight testing in favor of more ground testing and a reduction in the effort to be provided by a second source contractor.

In the BM/C3 area, major changes in the operational concept and hardware definition resulted in a 50% acquisition cost reduction. The key modifications were: change in the size and acquisition strategy for obtaining a dedicated SDS fiber optics network; a reduction in the estimated real-time software requirements; elimination of an Airborne Command Center (ACC) component; and, utilization of a larger number of existing ground segment command centers.

The Systems Engineering & Integration (SE&I) acquisition costs were reduced by 36% due to significant changes in the functions of the SE&I segment. These included a reduction of overlapping integration and test software development efforts, a reduction in centralized integration facilities and hardware (versus distributed facilities to the elements), elimination of centralized training and training software development, and the elimination of the requirement for centralized integration and simulation hardware.

Mr. MCCURDY. And, of course, your cost is now 50 to 55 billion. There were reports yesterday of a letter from General Abrahamson to someone that was on the news last night that indicated that he felt--I don't know--that a $25 billion system was in order. Is that an accurate description of such letter?

General MONAHAN. I believe he did say that, in the paper that I read.

Mr. MCCURDY. To whom was the letter written?

General MONAHAN. What you are quoting from is his end-of-tour report that he sent to the Deputy Secretary of Defense.

Mr. MCCURDY. Was it a classified document?

General MONAHAN. I don't believe so.

Mr. MCCURDY. Oh, here it is. Trusting staff always has everything.

What he says is, ''Adding BSTS to the system as a replacement for DSP and a redundant warning capability along with the required command and control capability would add 15 billion, for a total of research development and deployment costs for approximately $25 billion.'' Is he just talking about Brilliant Pebbles?

General MONAHAN. I think I would have to reread exactly what it was he said because I read that--the end-of-tour report, a few weeks ago. First of all, he is talking about Brilliant Pebbles, but then he is talking about other sensor

and command and control elements that would have to go along with that. I think he is including the BSTS, for example, although I can't recall for sure.

Mr. MCCURDY. So when--

Mr. KYL. Excuse me, if the gentleman would yield, I think I can shed some light on that.

He has two total costs. First of all is the cost of the phase 1 system that would include a space-based component. That is 25 billion, comprised of three things: $10 billion, approximately, for the Brilliant Pebbles component; $11 billion for the surveillance satellite and telecommunications portion of it; and $4 billion for the support structure ground command and control. That total is 25 billion.

Then, for the ground-based portion of that, with which you are familiar, there is an additional 25- to 30 billion, for a total of 50 to 55 billion.

Mr. MCCURDY. So he is basically saying that your numbers, 50 to 55, as a cost goal for a SDS system is consistent with what this letter is. This is no new revelation then? He is saying it is a total system of 50 to 55, or is he saying, no, he disagrees with your 50 to 55 number and saying it could really be for 25? I am confused here.

General MONAHAN. I really don't know the answer to that, either, Mr. McCurdy.

Mr. MCCURDY. Does the gentleman from Arizona know?

Mr. KYL. It is just a matter of two components. In his letter, he describes the space-based component, with all of its bells and whistles, would be 25. Then add the ground-based component for another 25 to 30. Add them together; you have the total of 50 to 55.

Mr. MCCURDY. So the reports on the news last night were somewhat exaggerated, which is not unusual, but--in saying that they really felt that it could be done for 25, which seems to be--for a total system would be unrealistic. I mean, you have no knowledge whatsoever of a total phase 1 system that could be built for 25 billion, right?

General MONAHAN. Phase 1 system, as it is laid out here, clearly could not.

Mr. MCCURDY. What is your best guesstimate of the phase 1 cost?

General MONAHAN. Sixty-nine as of the moment. As we press forward and try to do better in the research arena--one of our major goals in the program is to get the cost down. I don't know how low we can get it, but--

Mr. MCCURDY. Can you give me the figures on the BSTS, what your best figure is for just that portion of it? Is that consistent--

General MONAHAN. For the BSTS part of the program? In 1988 dollars, it is a total of 8 billion and that is

research, development, acquisition costs.

Mr. MCCURDY. Eight billion? How many deployed, and again, interrupt me if I get into an area we need to discuss in--

General MONAHAN. It is six BSTS deployed.

Mr. MCCURDY. And this is a multispectral system and all the bells and whistles?

Mr. DELLUMS. Would the gentleman yield just for one quick second?

General, would this BSTS provide battle management capability, and if so, would that capability then make this nontreaty-compliant?

General MONAHAN. BSTS perhaps could. We haven't arrived at all those decisions yet. We are still on the demonstration/validation phase, so the final spec isn't written.

Mr. DELLUMS. I thank the gentleman for yielding.

Mr. MCCURDY. Certainly.

Again, I have to be careful here, but I am somewhat concerned. I have two other committee assignments. One is the Science and Space Committee and the other is the Intelligence Committee. Having some knowledge of satellites systems and the cost of those, at least from the cost standpoint that we are always being presented with, I find a rather ambitious undertaking for a total system with that

capability within those costs.

Are you telling me that this is again some technology breakthrough or--

General MONAHAN. No.

Mr. MCCURDY. Perhaps at some stage, we could go into a classified arena and you could show us in a little more detail what you--how you are going to pull this off.

General MONAHAN. Right. I think, Mr. McCurdy--

Mr. MCCURDY. I mean, launch costs alone are running in the hundreds of millions of dollars these days.

General MONAHAN. Certainly. Satellites--average cost is about $20,000 a pound, historically. Except GPS, I think we got it down to 10,000 because we finally bought a bunch in a roll.

I feel good with the $69 billion estimate. Why? Because it was developed from the bottom up. It came from the people who are going to develop it to begin with. So it came from the Army and the Air Force and the other elements, the other--our other agents. That is the first thing.

The second thing is it was subjected to an independent review conducted by the SDI ~~Office~~ Organization and then another independent review by the cost analysis group in the Pentagon. So it went through the formal rigorous cost-estimating procedure and then went through all the various checks associated with it.

I don't know how you--

Mr. MCCURDY. What year dollars are you using?

General MONAHAN. Those are fiscal year 1988.

Mr. MCCURDY. In the January 23rd issue of Aviation Week, officials--Grumman said that BSTS would cost roughly 30 billion over several decades. Is that--

General MONAHAN. Thirty billion over several decades?

Mr. MCCURDY. Yes.

General MONAHAN. Okay.

Mr. MCCURDY. Life-cycle versus--you know, you guys come up here and you give us 1988 dollars versus 1990 and--I don't know the numbers here.

General MONAHAN. I gave you--what I gave you there for BSTS were the costs to do phase 1, phase 1 on the program, which is the first six BSTSs. If you are going to keep BSTS going another 50 years, obviously you will spend a lot more money.

Mr. MCCURDY. So you are saying an initial deployment of a complete system, even though it is not life-cycle--long-term, would be, what, number six to nine?

General MONAHAN. Eight billion dollars for the first six BSTS systems and that does not include operating and support costs and does not include anything beyond those first systems. I believe the number six is correct.

Mr. MCCURDY. That is both ground and--

General MONAHAN. It buys three spares, so that is a total of nine--

General MONAHAN. --support systems for--

General MONAHAN. Yes. It is, right.

Mr. MCCURDY. We would like to see some specific breakdown for that.

Just one last question. On your strategic review that is ongoing, the--as of this stage, there has not been a decision on a ALPS versus a phase 1--I mean, you still maintain that phase 1 is your deployment scenario that you prefer. Is there discussions within the strategic review or have you been tasked by whoever is in charge over there right now to come forward with an ALPS review?

General MONAHAN. Some of the options that we have under consideration in the strategic review do include ALPS as part of it.

Mr. MCCURDY. When will that review be forthcoming?

General MONAHAN. I don't know what the final schedule is. I mentioned earlier I think within the Organization, we should have most of our work done this month. Then it has to go forward for further reviews.

Mr. MCCURDY. Including budget numbers or have you already submitted those?

General MONAHAN. No, we are working budget numbers at the same time.

Mr. MCCURDY. Were you given a fair hearing, as they say? Are you exempt from all the Bush bogies?

General MONAHAN. I don't know that I am exempt from anything, but I have not been given any bogies.

Mr. MCCURDY. You specifically examined--I mean, when they said, ''DOD come up with a 2 percent reduction or whatever,'' SDI was exempt--

General MONAHAN. We did not participate in that exercise, right.

Mr. MCCURDY. Thank you.

Thank you, Mr. Chairman.

Mr. DELLUMS. The gentleman yields back his time.

Mrs. Byron is recognized for such time as she may consume.

Mrs. BYRON. Thank you, Mr. Chairman.

General, let me follow along on the funding and the budget aspect, because over the last five years, you have been under-funded each year, although last year you came the closest to the requested funding.

RPTS TETER

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How long can you under-fund a system in a development stage and stretch it out again and again, barely, in some cases, keep the program alive, keep your technical team together, or is it not better to regroup, draw down, narrow the scope and operate within the funding levels that have been given you?

General MONAHAN. I think if you keep having the wild swings all the time and you don't get the stability, before very long, people are probably going to start losing interest. An awful lot of the value that we get out of the program is--the American industry, noting that the United States Government has an interest somewhere and is willing to press on after a certain program, tends to put an awful lot of their own resources into it. We reap a benefit from that and it is kind of a benefit that we don't pay for, at least indirectly, so that is something that would be affected.

Mrs. BYRON. I think I would be less than candid to say that the SDI program is somewhat battered. I look in the future, and I think that is one of the missions that this subcommittee has down the road, and I am looking for some vehicle that we can excite the younger generation to take the courses early on to get the advanced degrees, to put in

the commitment to want to go to be a part of it.

We saw that in the 1960s when many of you--I am sure your teen came home and said I want to be part of that group that is going to go to the moon. I don't see anybody coming home and saying, I want to be part of SDI when I grow up.

At what point--and this follows on the chairman's comments and line of questioning--at what point do we have to make the decision to go nuclear or non-nuclear? I had asked this question previously about three or four years ago and the answer I got at that time was, oh, it is way down the road. Well, we are three or four years later and I envision a serious problem with a large number of members if you bring in that buzz word as part of the system.

General MONAHAN. As I mentioned earlier, to do the entire phase 1 program, there is nothing nuclear that has to be done at all. Indeed, if you stay with the kinetic kill vehicles, both space-based and ground-based, there is no reason in the world to have anything nuclear associated with SDI. The possibility of nuclear occurs when considering space-based laser and ~~would~~ whether a nuclear reactor be required to power a space-based laser.

We don't know the answer to that yet, but that is a possibility. There was also, at one time, some notion that perhaps x-ray lasers, which would derive from a nuclear event, would be an effective directed-energy weapon in

space. But ~~that~~, again, nobody really has to go there.

So, other than that, as I said, the only time that you would be faced with such a decision is, first of all, if we, as a nation, decided we would put directed-energy weapons in space and decide to do that. Then we should know at about the same time whether or not nuclear power would be required for them.

Mrs. BYRON. I have one final question and that is, it seems to me, looking at the battle that we have year in and year out on the ASAT program, it is going to be very difficult to get that step done. But it also seems to me to go from point A to point C, you have to stop off at point B and point B is ASAT. Would it not be more cost-effective to combine the two programs?

General MONAHAN. No, I don't believe that it would, to tell you the truth. Obviously, both programs can probably use some bits and pieces from the other, but they really have quite different missions to perform.

Mrs. BYRON. Thank you, Mr. Chairman.

Mr. DELLUMS. The gentlewoman yields back the time.

Mr. Weldon has returned and the Chair would like to provide the gentleman an opportunity to question and yields to the gentleman such time as he may consume.

Mr. WELDON. I thank you, Mr. Chairman, for yielding and I apologize for having to leave. I have hearings going on at

three different committees at one time.

Just one line of comment and questions I want to pursue was that relating to the ABM pre-discussions. As we all know, any discussion of a treaty requires adherence on both sides and one of my concerns is that while we were talking extensively about SDI as a potential breakout for our country on the ABM Treaty, that we, in fact, have acknowledged on various occasions that the Soviets have been, in fact, in violation of this same treaty in several situations, not just with their own work and potential work on SDI, which 10 years ago they were openly denying, and as recently as five years ago, in discussions I have had in Moscow, they were denying that they were doing any Soviet--any work on SDI technology, yet our intelligence was telling us something different by the photographs that we have of laser generators and particle beam operations that we had seen were being developed in their country.

Last week, Andre Kokoshyn testified before our Defense Policy Panel and admitted that the Soviets have been, in fact, exploring their own SDI as recently as six years ago, but in his terms, they had given up on the technology, which I find somewhat hard to believe. My point is that any discussion of the ABM Treaty and the potential for SDI operations to have us break out of that treaty has to also be looked at in light of what the Soviets, in fact, are

doing along the same line.

One of the things that has bothered me is that I have felt, in my two and a half years or two years plus three months in Congress that we haven't always had access to the full information about Soviet ABM compliance, as well as potential for Soviet ABM breakout.

On last year's defense bill, I included a piece of legislation that requires DOD to come up with a report, a classified and unclassified report, on the potential for Soviet ABM breakout. I would like to have you, if you would, General, check into the status of that because I have not received it yet, and I would also like to ask you, Mr. Chairman, if you would, to consider holding a confidential closed briefing for members of this subcommittee on what the Soviets are doing in the area of SDI work. Using our latest available intelligence, I had arranged a similar briefing in the last session and had about seven members of the Armed Services Committee sit through a briefing by defense intelligence and Air Force intelligence. I think an updated version of that would be useful to us as we consider SDI, both from our standpoint and from the Soviets are doing in this year's round of discussions and debate.

So I would ask you, Mr. Chairman, if you could arrange the--

Mr. DELLUMS. If the gentleman would yield, the ranking

minority member, Mr. Dickinson, already pursued this general line of questioning and we have informally agreed that we would create a forum that will allow this kind of classified information to come to all the members of the subcommittee, so we will deal with it.

Mr. WELDON. I thank the chairman and I will yield back the rest of my time. Thank you.

Mr. DELLUMS. The gentleman yields back his time.

Does the gentleman from California, Mr. Hunter, seek recognition?

Mr. HUNTER. Thank you, Mr. Chairman.

Just a fast question and I thank you very much, Mr. Chairman, for allowing me to come in late in this hearing. I apologize. I, too, have a number of committees going.

It appears to me that war-fighting scenarios in the way the world works and history works, that usually the truth is stranger than fiction and I recall a couple of years ago, we were looking over the possible conflicts in the world, where conflicts might appear, the Falkland Islands situation was the furthest from any of the perceived problems or expected problems, and yet, that is where we saw a major conflict.

In the same sense, it appears to me that of the nations that are on their way to gaining ballistic missile capability, probably the one we are preparing most strongly against, the Soviet Union, is not as inclined, at least at

this time, to strike the United States as some other nations are, may be or possibly will in the future.

I think it is very important that our SDI program fit the threat, I guess is what I am saying. I just wondered, General, how many nations are going to have ballistic missile capability by, say, the year 2000? Do you have any reading on that? Aside from the Soviet Union and China?

General MONAHAN. It is quite a few, Mr. Hunter. I don't remember the number itself, but I can get it for you.

Mr. HUNTER. One thing that I am concerned about is that we build a system, if we are going to, indeed, move ahead--I think we should move ahead and we should build a system. I think if you can't stop missiles, you can't defend your country, but I think it is important that we build to the threat and fit the threat.

I wonder if you could get for the record, with the indulgence of the chairman, an analysis of the holders of ballistic missile capability by the year 2000 and maybe shortly beyond for this?

General MONAHAN. I would be happy to do so.

Mr. HUNTER. Is that--

Mr. DELLUMS. Yes, without objection.

[The information follows:]

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Answer provided in SECRET addendum to transcript.

Mr. HUNTER. Thank you, Mr. Chairman.

Mr. DELLUMS. The Chair would note that it is a little after 12:00, but sometimes we have gone to 12:30. The Chair would like to indicate to the gentleman from Arizona that he said that, time permitting, he would be happy to yield to the gentleman for any follow-on questions. If the gentleman wants to ask questions, the Chair would yield to the gentleman for that purpose.

Mr. KYL. Thank you, Mr. Chairman.

I would like to note that I, too, had hearings this morning, but I stuck it out here because you are here, General Monahan, and I wanted to be here with you this morning.

Mr. DELLUMS. The gentleman is always there.

Mr. KYL. In view of the time, I would simply like to quickly go back over one subject and then I am sure we will have other opportunities to get together, because both you, Mr. Chairman, and Mrs. Byron, who is no longer here, were concerned about the nuclear components.

I just want to quickly understand this. It is true, General Monahan, that the Soviets do use nuclear power in space now and that we do not; is that correct?

General MONAHAN. That is correct.

Mr. KYL. And it is also true that their ABM system uses a nuclear--or at least part of their ABM system uses a nuclear

warhead and we don't have any such--

General MONAHAN. I believe, yes, that is true.

Mr. KYL. Thirdly, their long-term research, as ours, does in part look at some nuclear components primarily for power purposes, but perhaps even theoretically a laser for weapon way down the road. Is that correct?

General MONAHAN. They could. It could be.

Mr. KYL. Is it also true that part of the reason we research these things is so that we can understand what the Soviets might be doing--

General MONAHAN. Yes.

Mr. KYL. --not necessarily to deploy a system ourselves.

Fourth, that all of our phase 1 defense, you said, is non-nuclear--

General MONAHAN. That is true.

Mr. KYL. --as it is proposed.

General MONAHAN. That is true.

Mr. KYL. This isn't necessarily your area, but I think you--and we all know the answer to this question--is it not also true that all of our strategic offensive deterrent is nuclear?

General MONAHAN. The word ''all'' gets to be--

Mr. KYL. An awfully large part of our strategic offensive deterrent is nuclear.

General MONAHAN. You have to be at least 99 percent

correct with that statement.

Mr. KYL. As Perry Mason says, Mr. Chairman, ''I rest my case.''

Mr. DELLUMS. The gentleman yields back his time.

General, we talked informally in our introductory meeting about the relationship between SDI and ASAT. I would like to bring you to that issue on the record.

In your prepared remarks, you spoke of protecting the SDI components from ASATs and would you please explain how this will be done. My follow-on question is this: If it can be done to components--that is, protect--components of SDI, why couldn't the same measures be taken to protect our satellites, therefore removing the need to develop ASAT? However, if SDI components can't be fully protected from ASAT, wouldn't that mean that a fully deployed ASAT program would render SDI vulnerable and therefore not survivable?

General MONAHAN. Okay. Let me just do my best that I can to answer that without trying to get classified.

I think you would have to look at it philosophically that there is probably no such thing as a perfect ASAT; there is no such thing as an absolutely perfect satellite system that is immune from an ASAT either.

Mr. DELLUMS. Let's contemplate a laser ASAT program.

General MONAHAN. Okay, but even with a laser ASAT, I believe that you would have ways to counter lasers, so--just

because a laser ASAT may be one way of doing a job, there are ways--like I say, I want to keep from getting classified here, but there are ways to develop countermeasures against lasers also. So that part of it is not hopeless.

I don't think you can talk very definitively one way or the other on the subject, and I think there would be a give and a take. We have electronic warfare equipment that ~~we~~ has ~~have~~ been~~--~~constantly ~~has been~~ updated over the last 30, 40 years that--it operates--you know, certain of the radio frequency equipment radars, et cetera, can operate very well on certain jamming environments. Other jamming environments, they can't work quite as well. It is a system of measures, countermeasures and counter-countermeasures. I think you are looking at the same thing here when you look at ASATs and also look at satellites.

But when you have one side, the reason for the high priority on ASATs, of course, is that the Soviets have that capability today, and they can take down a lot of our satellites we have up there today, but theirs go scott free as of present time. We don't have a way to fight back. So that is what is behind the ASAT priority.

Mr. DELLUMS. Does the gentleman from Pennsylvania have any additional questions?

Mr. WELDON. No.

Mr. DELLUMS. If not, General, we would like to thank you

for your presentation this morning.

The Chair, without objection, would submit a number of written questions and ask you to respond for the record.

[The information follows:]

*********** COMMITTEE INSERT ***********

Mr. DELLUMS. Again, we appreciate your presentation this morning. The Chair would like to indicate to my colleagues that we will meet tomorrow morning at 10:00 a.m., in 2118, where the subject matter will be the ASAT program.

The subcommittee stands in adjournment until 10:00 a.m., tomorrow morning, room 2118.

[Whereupon, at 12:15 p.m., the subcommittee was adjourned, to reconvene at 10:00 a.m., Wednesday, March 15, 1989.]

*** SPEAKER LISTING ***

* * * * * * * * * * * *
* C O N T E N T S *
* * * * * * * * * * * *

STATEMENTS OF:

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* I N D E X O F I N S E R T S *
* * * * * * * * * * * * * * * * * * * *

INSERT NUMBER:

# HASC TESTIMONY

14 MAR 89

Lt Gen George L. Monahan, Jr.
Director
Strategic Defense Initiative Organization

# SDIO OBJECTIVES

**As Set Forth In DoD Directive 5141.5 "Strategic Defense Initiative Organization", Original Dated 21 Feb 86**

- **Conduct Vigorous Research Program To Develop Key Technologies For Defense Against Ballistic Missiles**
- **Consider Options To Increase The Contribution Of Defenses To US And Allied Security**
- **Protect Options For Near-Term Deployment Of Limited Ballistic Missile Defense**
- **Carry Out Program In Full Consultation And, Where Appropriate, With Participation Of Our Allies**



jm-0598

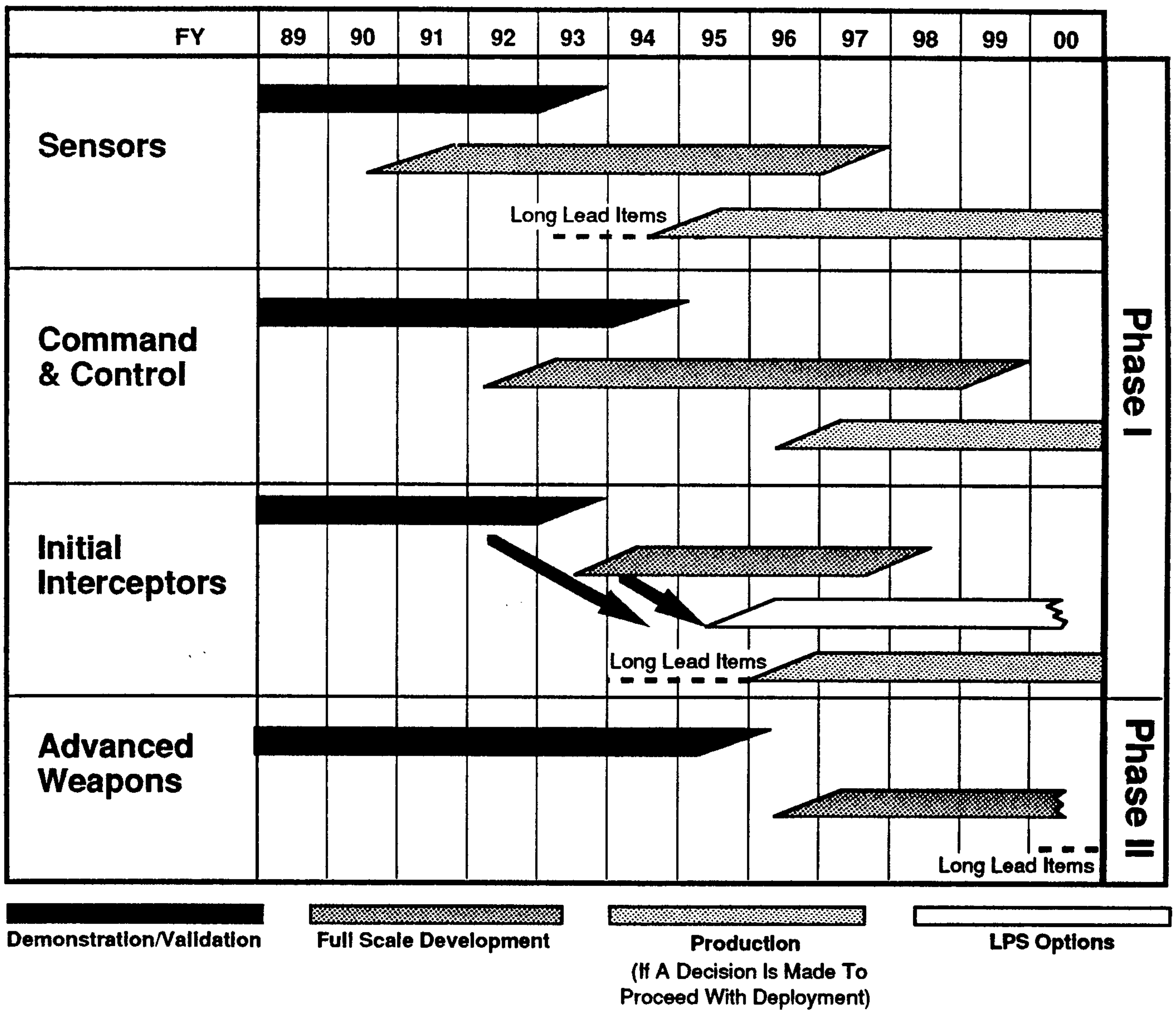
# CURRENT PROGRAM STRUCTURE

- Based On SDI Charter And JCS Requirement

- Defense Acquisition Board (DAB), October 1988

  - Multi-Phased Program
  - Phase I To Proceed Into Demonstration / Validation Phase
  - Subsequent Phases To Be Addressed At Later DABs

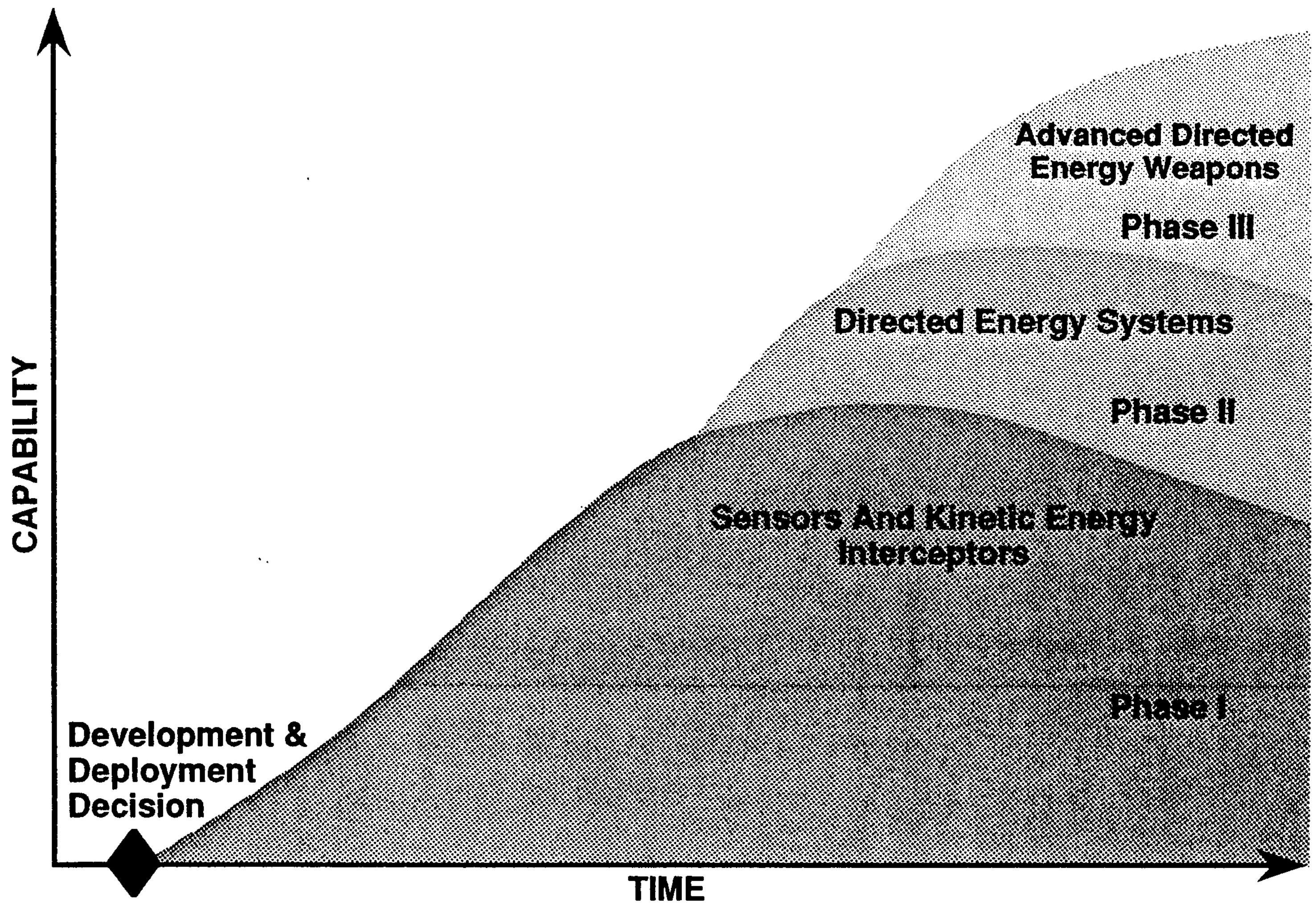
# SDS PROGRAM SCHEDULE
## (Oct 88 DAB)






jm-0557

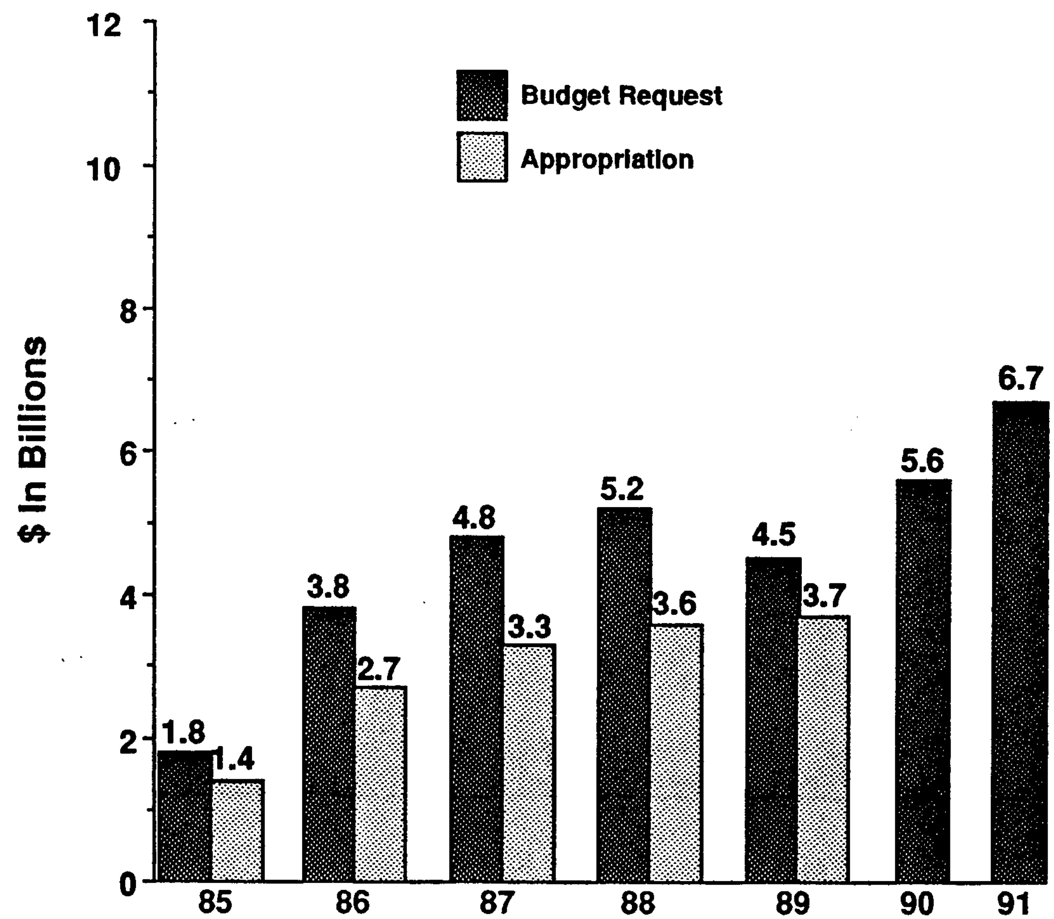
# THE PATH TO "THOROUGHLY RELIABLE" DEFENSES






jm-0558

# SDIO BUDGET

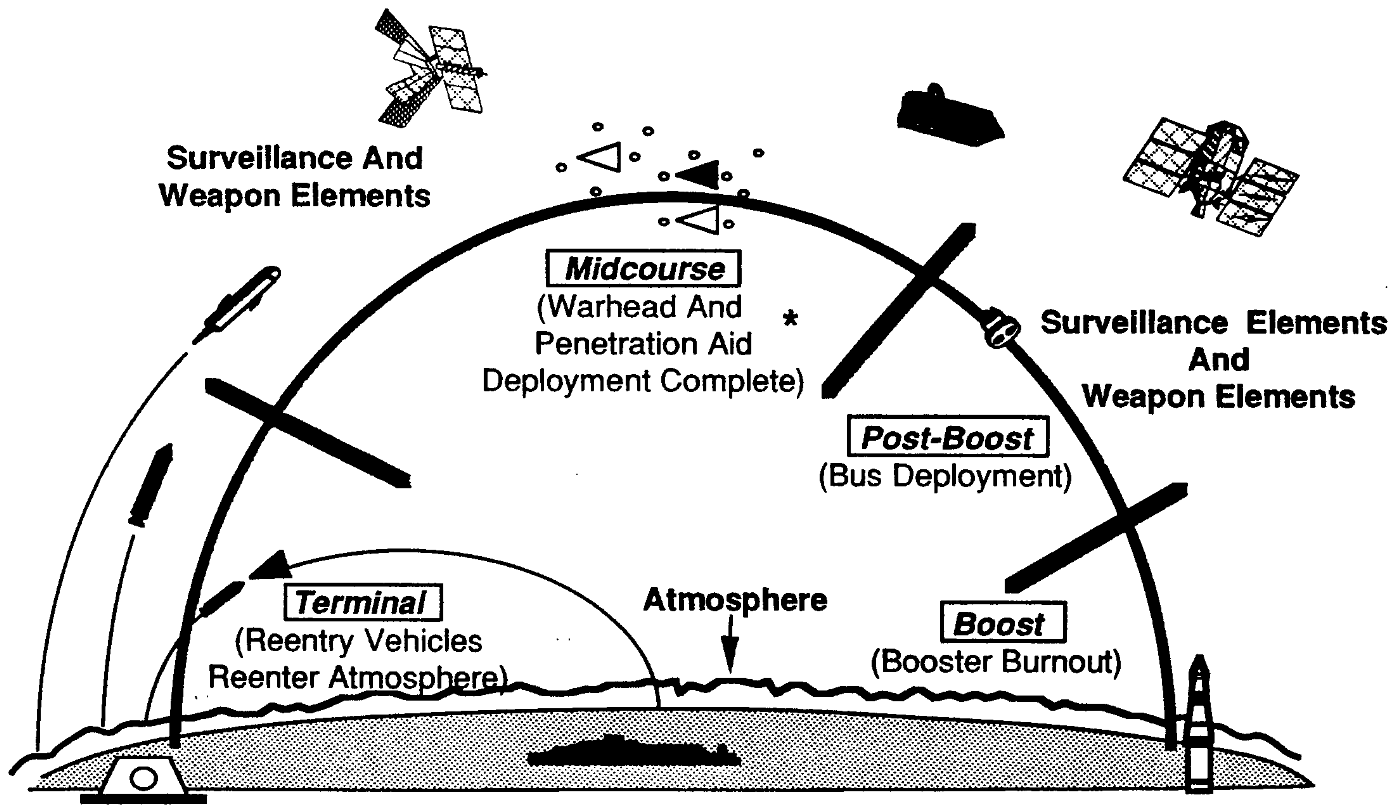



**$20.1B Requested / $14.7B Appropriated**



jm-0559

# SDS PHASE ONE ARCHITECTURE




**_We Are Building A System_**



jm-0560

# SDS PHASE ONE PROGRAM

## Major Elements

BSTS - Boost Surveillance And Tracking System

SSTS - Space Surveillance And Tracking System

GSTS - Ground-Based Surveillance And Tracking System

GBR - Ground Based Radar (Pending)

CC - Command Center

GBI - Ground-Based Interceptor

SBI - Space-Based Interceptor

# BOOST SURVEILLANCE & TRACKING SYSTEM

## Functions

- Surveillance - Continuous Global Observation Of The Earth's Surface
- Detection - ICBMs, IRBMs, SLBMs
- Acquisition - Initiate Tracking Of Missiles
- Tracking - Compute State Vectors And Predict Future Positions
- Typing - Determine The Missile Type
- Kill Assessment - Provide Data To Assist In Determination Of A Hit Or Kill
- Communications - Transmit Required Data To All Users
- Battle Management - As Determined By The SDS Architecture

## Characteristics

| | |
|---|---|
| Size: | Approx. 36 x 16 Ft. |
| Bands: | Multispectral |
| Sensor: | Scanning Or Staring |
| Power: | 6 - 10 Kw |
| Total Spacecraft Weight: | 5000 - 7000 Kg (11,000 - 15,400 Lbs) |

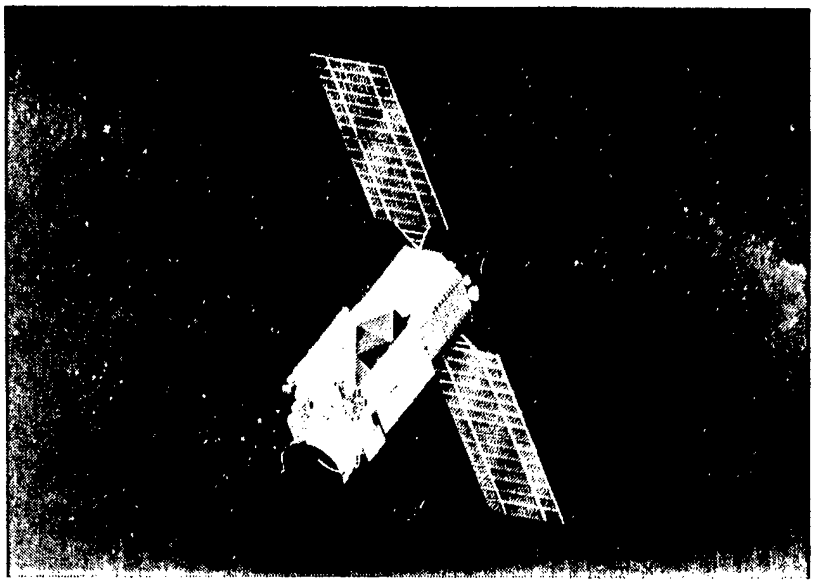


jm-0513

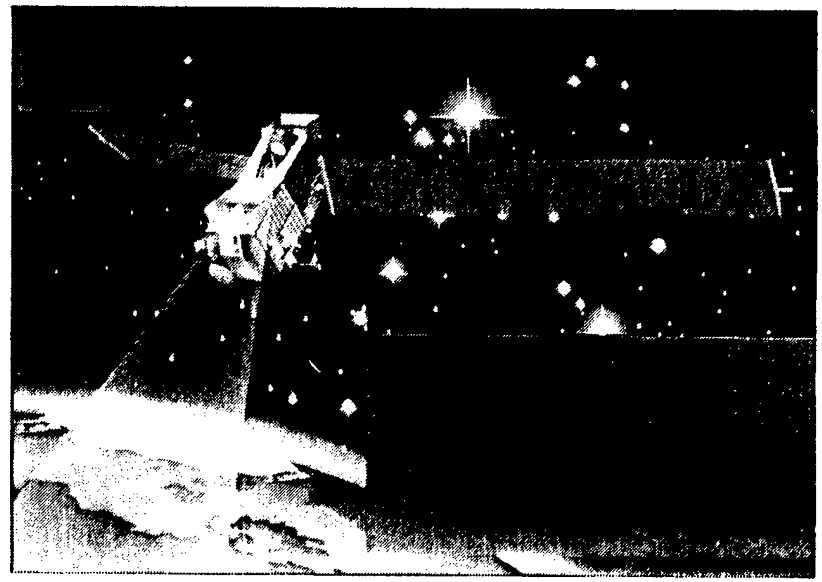
BSTS

# CURRENT SPACECRAFT CONCEPTS

GRUMMAN



LOCKHEED





VG 87U-1008/1
10 Feb 89

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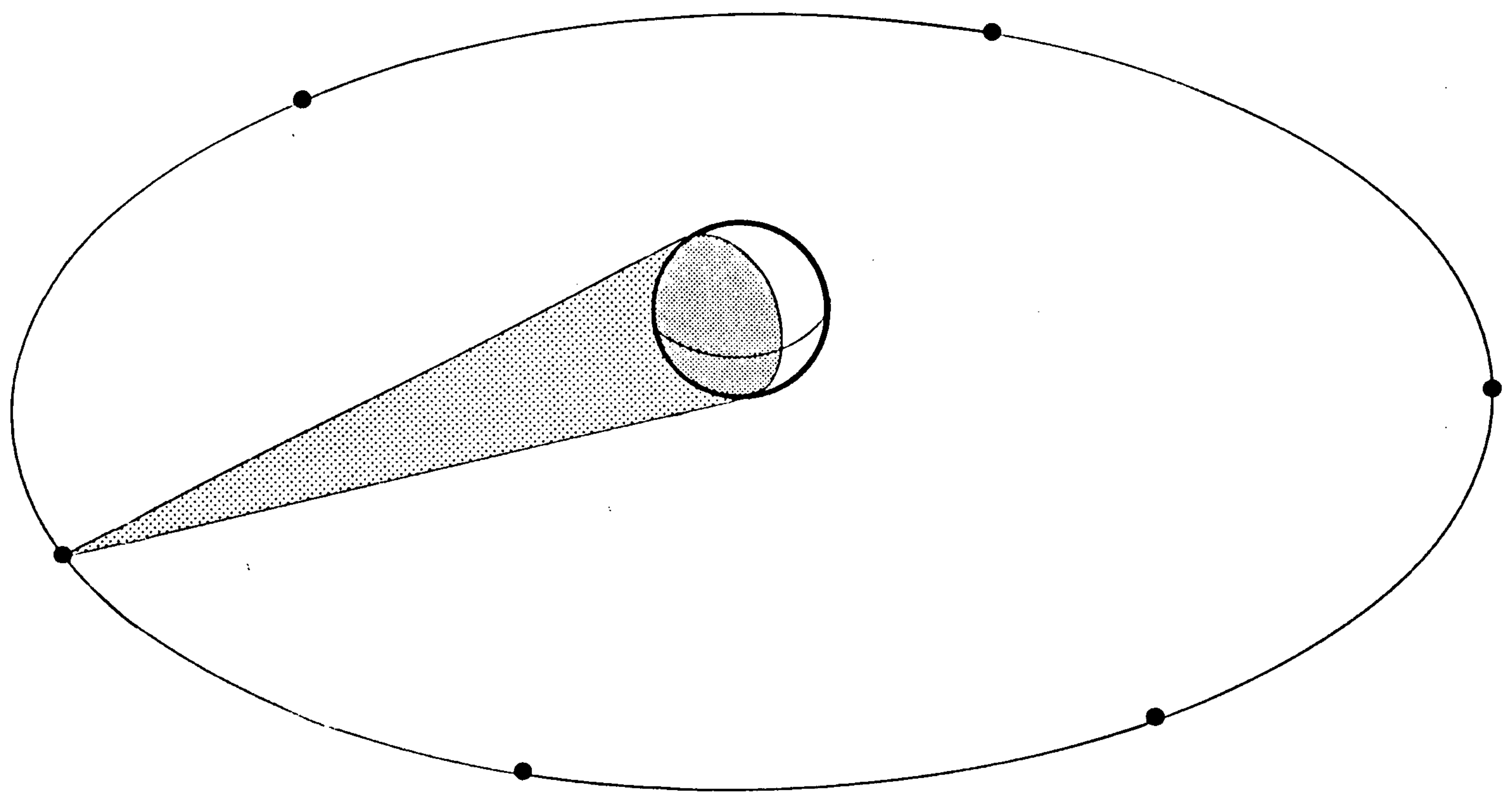
# NOTIONAL BSTS COVERAGE



UNCLASSIFIED

89U 0193
8 Feb 89

# SPACE SURVEILLANCE & TRACKING SYSTEM

## Functions

- Acquire And Track ASATs, PBVs, And RVs
- Fire Control For SBI
- Handover Unresolved Clusters To GSTS And GBR
- Space Surveillance Worldwide
- Foreign Target Data Collection

## Characteristics

| | |
|---|---|
| Aperture: | < 1.0 Meter |
| Sensor: | Scanning |
| Revisit Time: | < 10 Sec |
| No. Of Detectors: | $< 10^5$ |
| Bands: | Multispectral |

UNCLASSIFIED

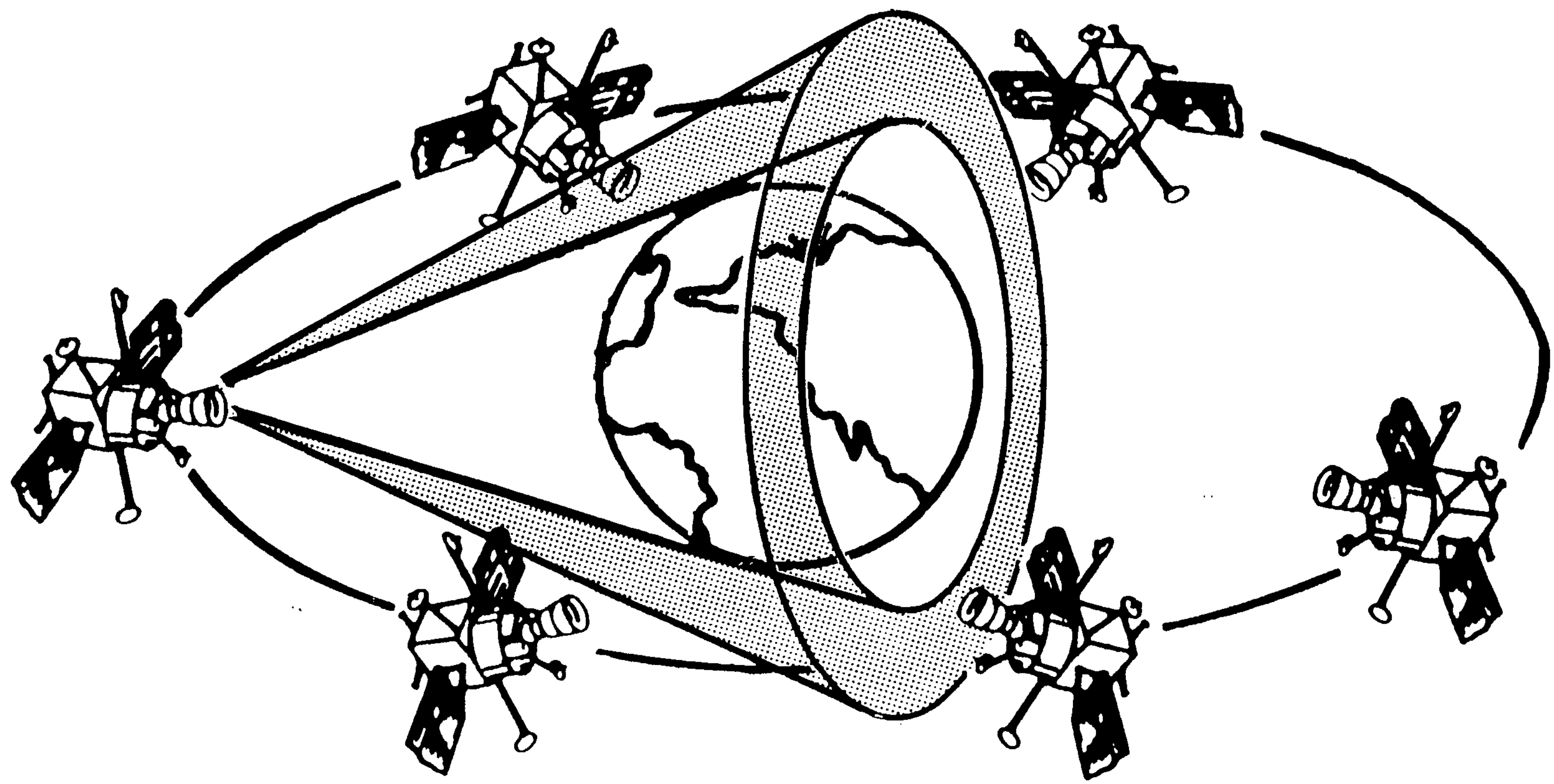
# SPACE SURVEILLANCE AND TRACKING SYSTEM (SSTS)

VG 87 U 0245 2
7 Feb 89

UNCLASSIFIED

UNCLASSIFIED

# SPACE SURVEILLANCE AND TRACKING SYSTEM (SSTS)



87U-1042/1
9 Feb 89

UNCLASSIFIED

# GROUND-BASED SURVEILLANCE & TRACKING SYSTEM

## Functions

- Track And Discriminate RVs From Penaids
- Reconstitution Of Space Surveillance Capability Due To Attrition
- Acquire & Track Low Altitude SLBMs

## Characteristics

| | |
|---|---|
| Aperture: | $< 1.0$ Meter |
| Sensor: | Scanning |
| Revisit Time: | $< 10$ Sec |
| No. Of Detectors: | $< 10^5$ |
| Bands: | Multispectral |

UNCLASSIFIED

# GROUND-BASED SURVEILLANCE AND TRACKING SYSTEM (GSTS)

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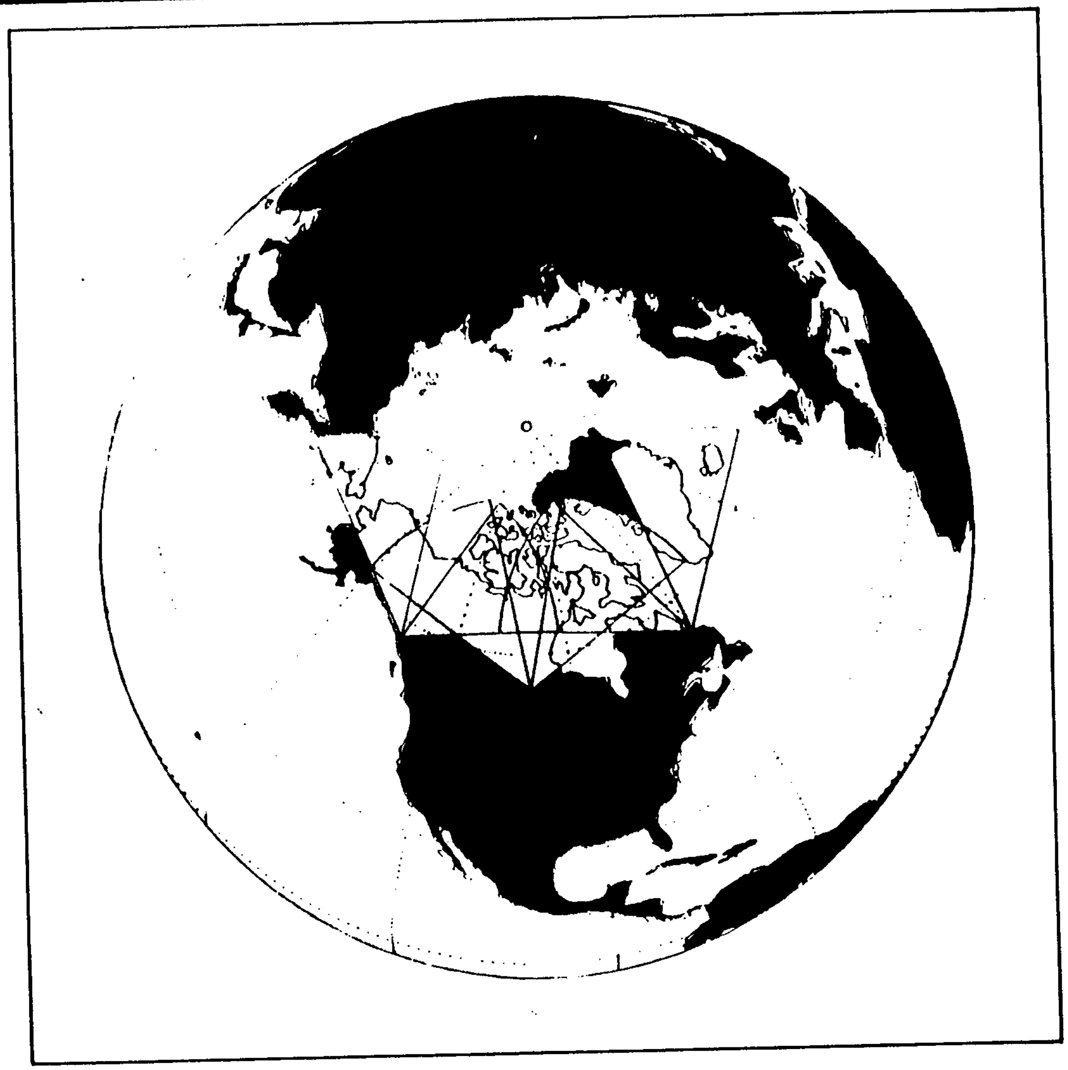
VG 88 U-1019 1
10 Mar 89

# GSTS COVERAGE



UNCLASSIFIED

89U 0191
8 Feb 89

# GROUND-BASED RADAR

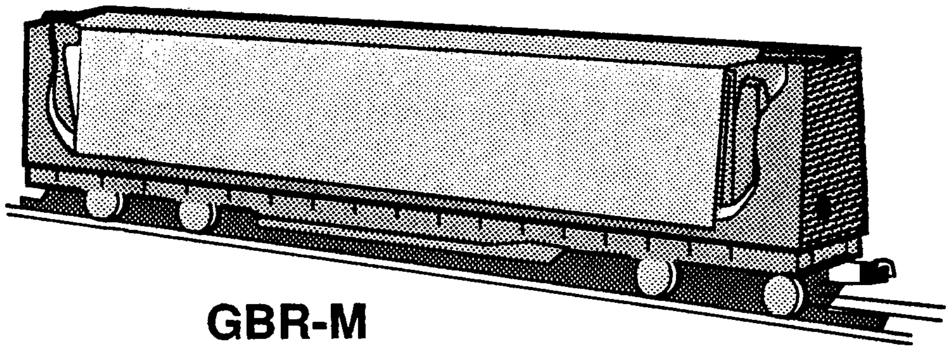
## Functions

- Acquire, Track & Discriminate RVs In The Presence Of Decoys
- In-Flight Guidance To Space And Ground-Based Interceptors
- Kill And Damage Assessment

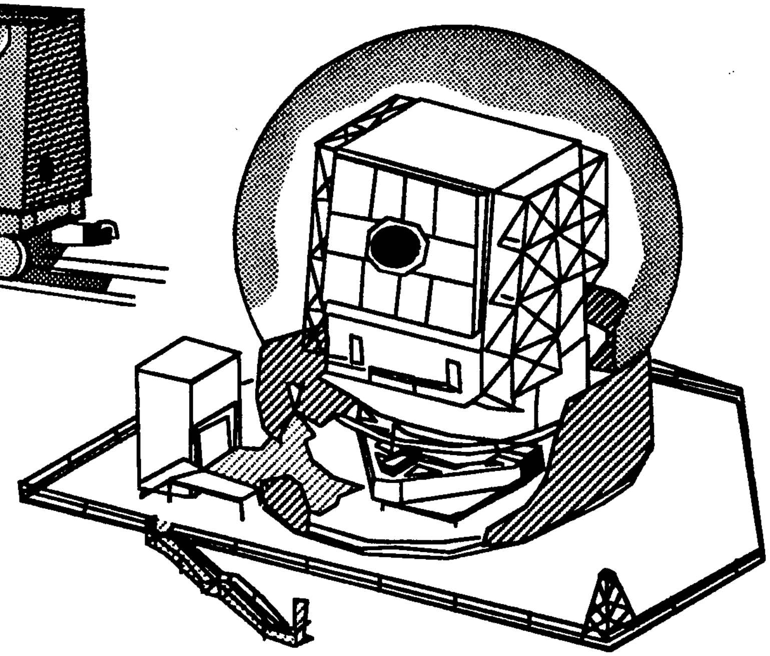
## Characteristics

- X-Band Phase Array Radar
- 290,000 Phase Shifters
- High Precision Range Resolution
- Rail Mobile Or Fixed Based

# GROUND BASED RADAR



GBR-M



GBR-X



jm-0562

# COMMAND CENTER

**Functions**

- "Man-In-Control"
- Global Attack Assessment
- Battle Plan Execution
- Real-Time Support To Other Warfighting CINC's
- Strategic Defense Reconstitution

**Characteristics**

- Fixed And Mobile Command Centers
- Robust Space And Ground Communiucation & Data Networks
- Multiple Interfaces With Unified & Specified CINC's

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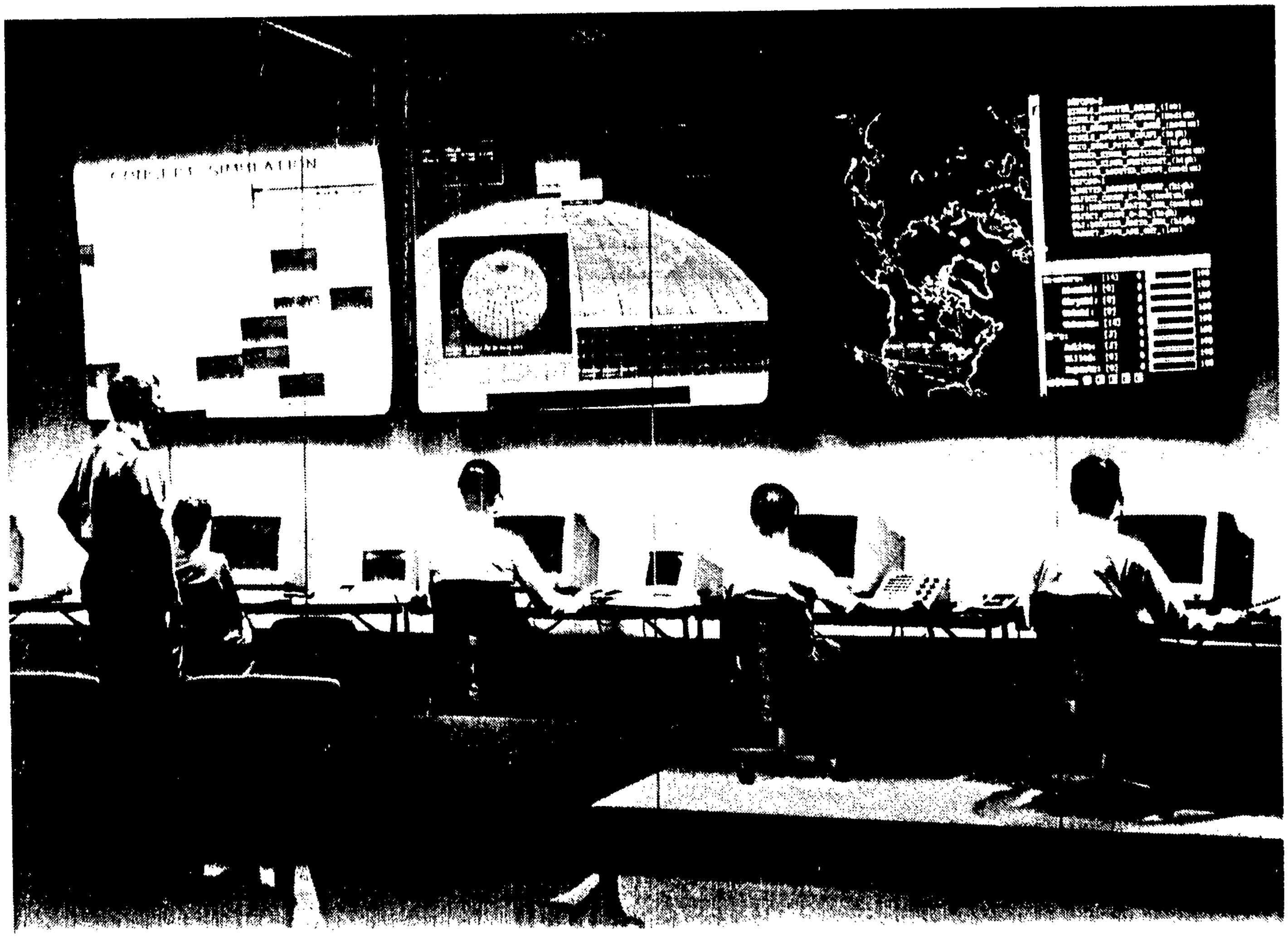
# EV-88 SIMULATION




UNCLASSIFIED

890 01.24
6 Feb 89

# GROUND-BASED INTERCEPTOR

## Functions

- Intercept RVs In Midcourse
- Provide Terminal Target Lock-On In Countermeasure Environment
- Provide For Adaptive & Preferential Defense Of Blue Forces And Targets

## Characteristics

- Low Cost
- Lightweight: ~700 Kg (1540 Lbs)
- Hit-To-Kill
- "Dormant" Missile Concept

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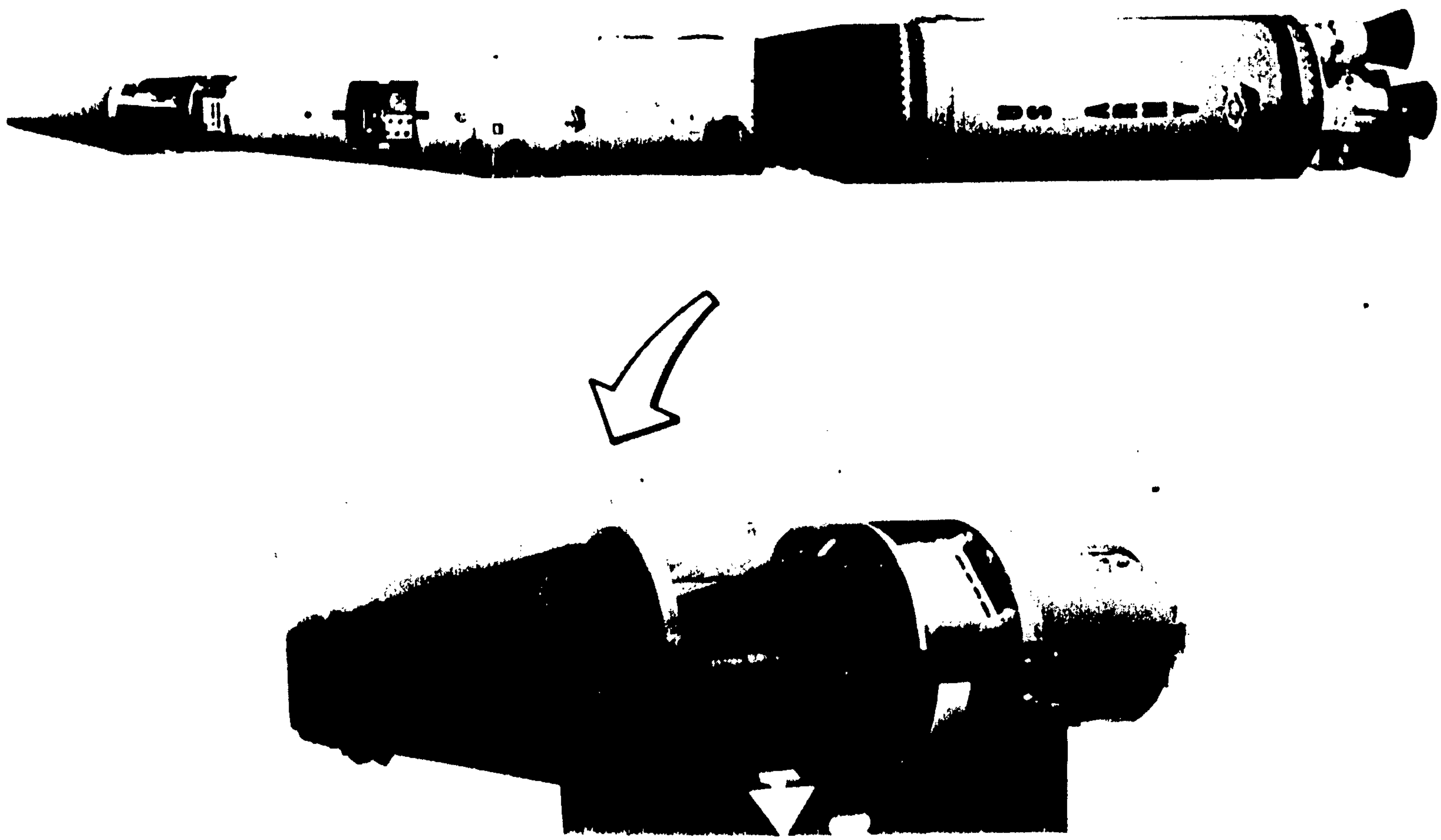
# GROUND-BASED EXPERIMENTAL INTERCEPTOR



UNCLASSIFIED

89U 0380
10 Mar 89

# SPACE-BASED INTERCEPTOR

## Functions

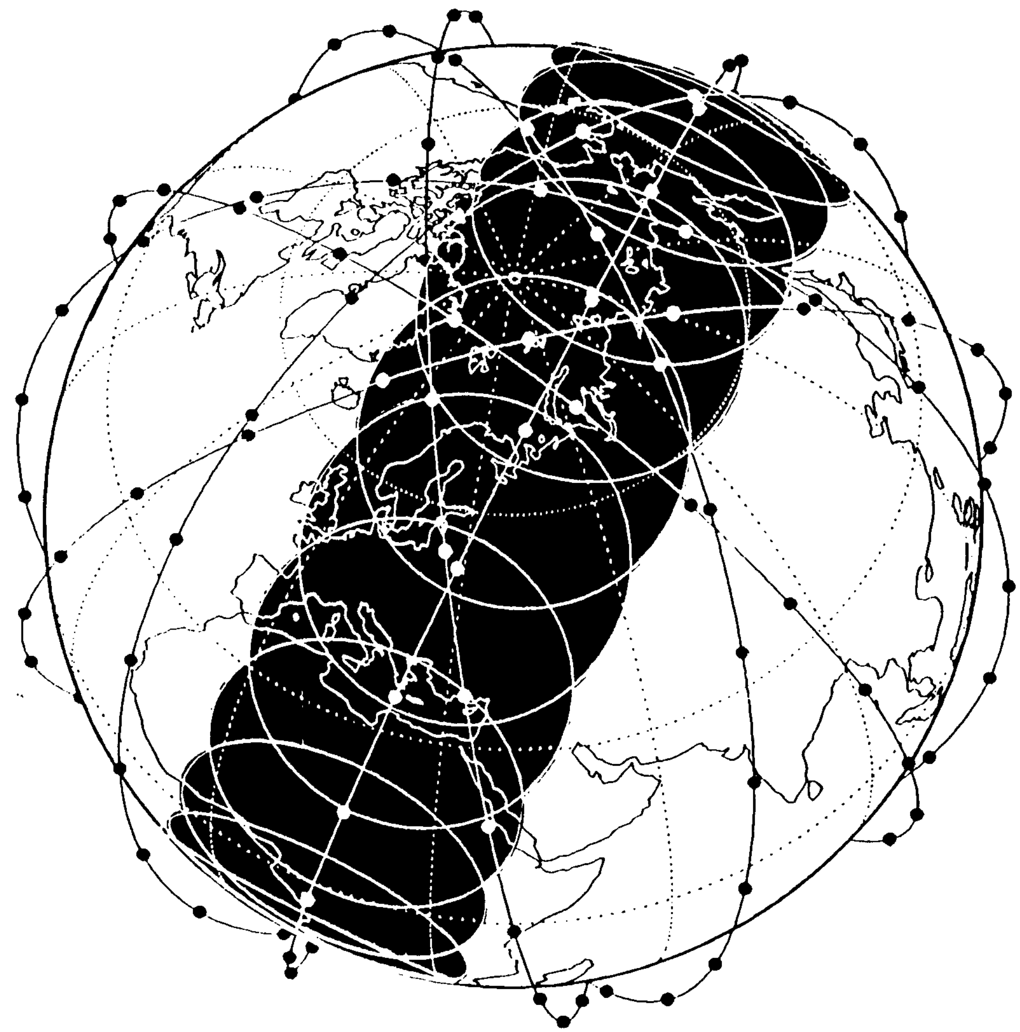
- Destruction Of Boosters, PBVs, RVs And ASATs In The Boost, Post-Boost And Midcourse Phases
- Target Lock-On And Steering During Terminal Phase Of Intercept

## Characteristics

- Carrier Vehicle — 3000 Kg (6600 Lbs)
- Interceptor — Low Cost / Long Life
- Hit-To-Kill

UNCLASSIFIED

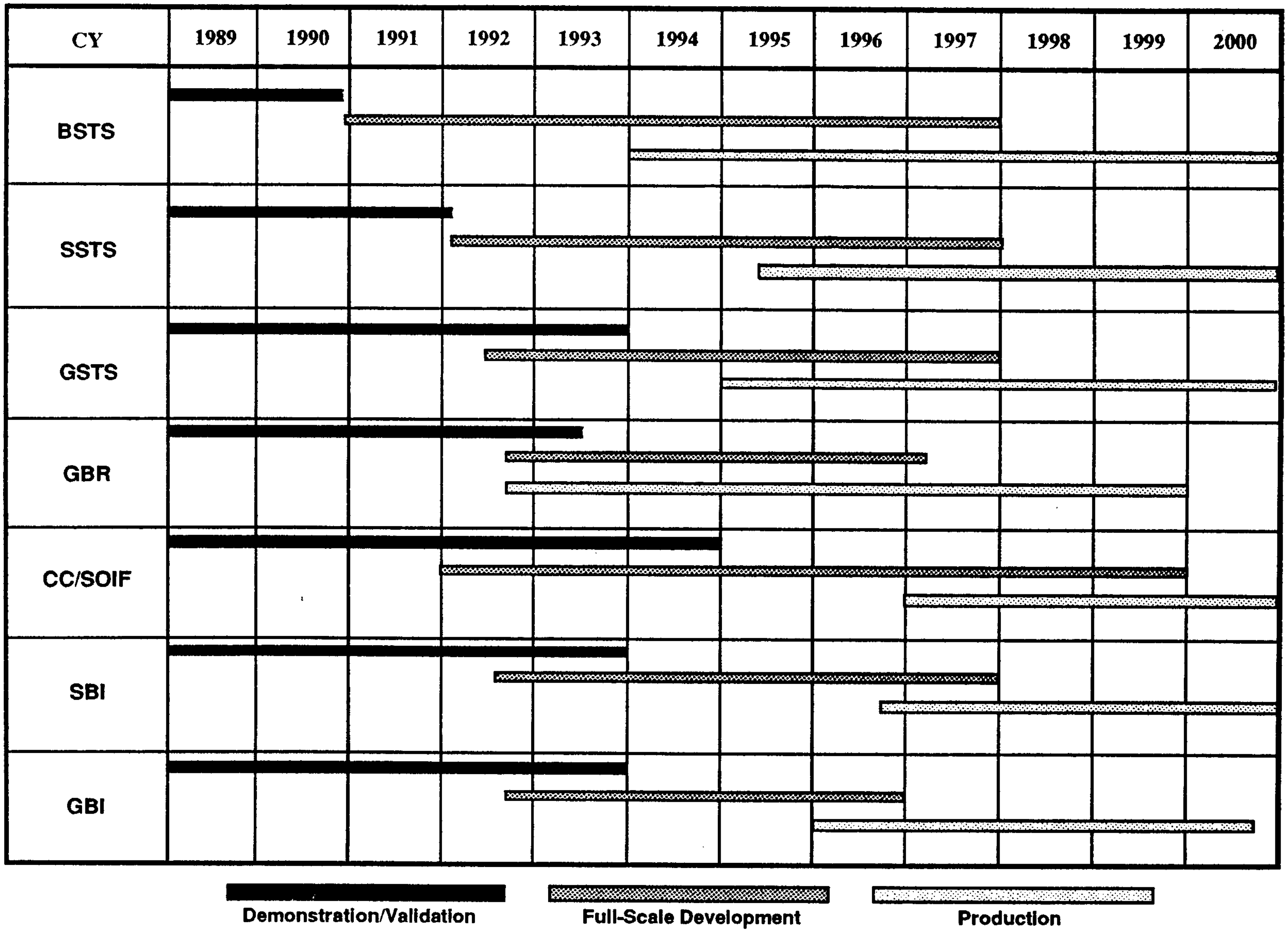
# SBI COVERAGE



UNCLASSIFIED

89U 0120
2 Feb 89
0739

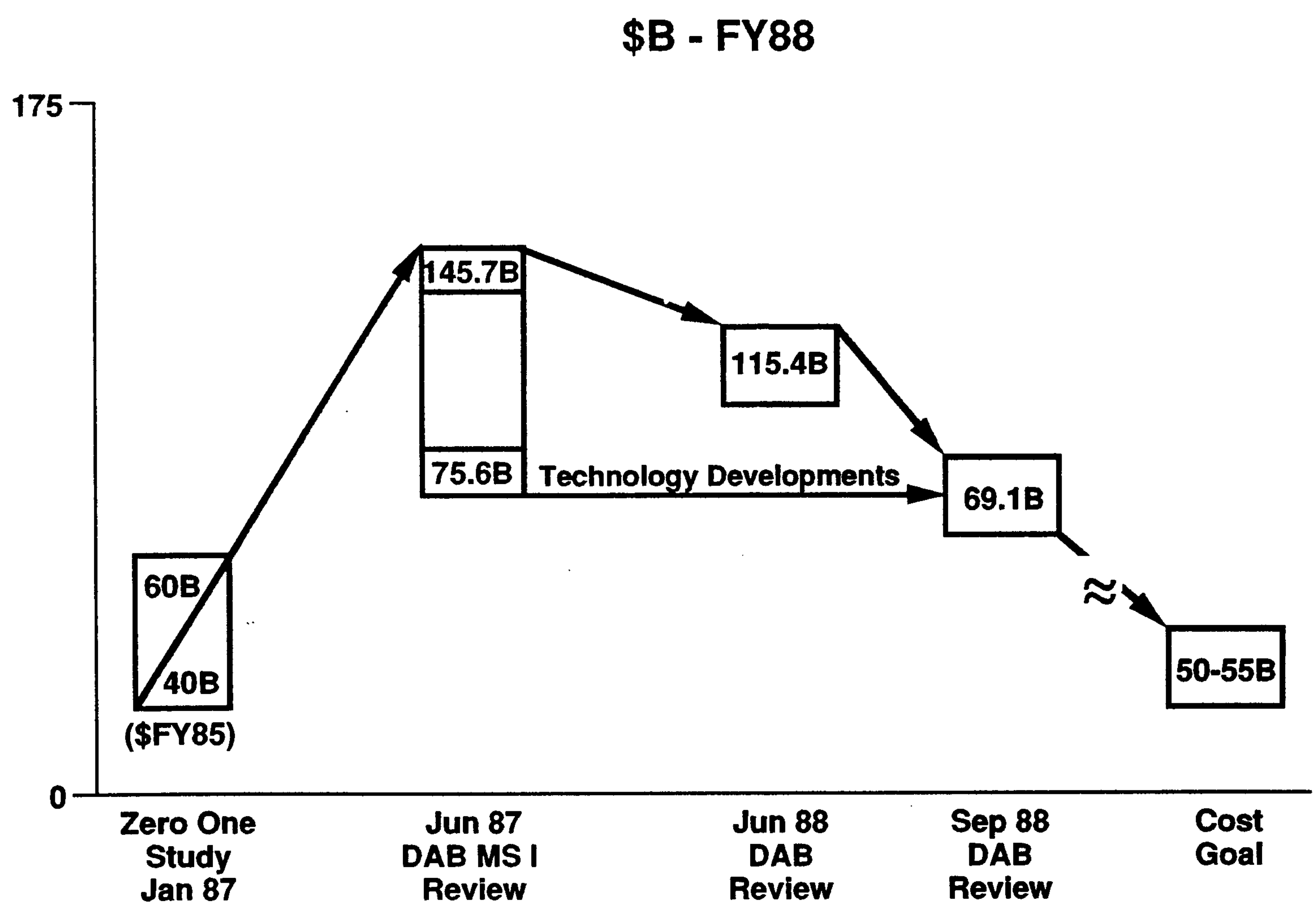
# SDS DAB PROGRAM






jm-0566

# SDS ACQUISITION COST EVOLUTION






jm-0567

# BRILLIANT PEBBLE CONCEPT - SBI

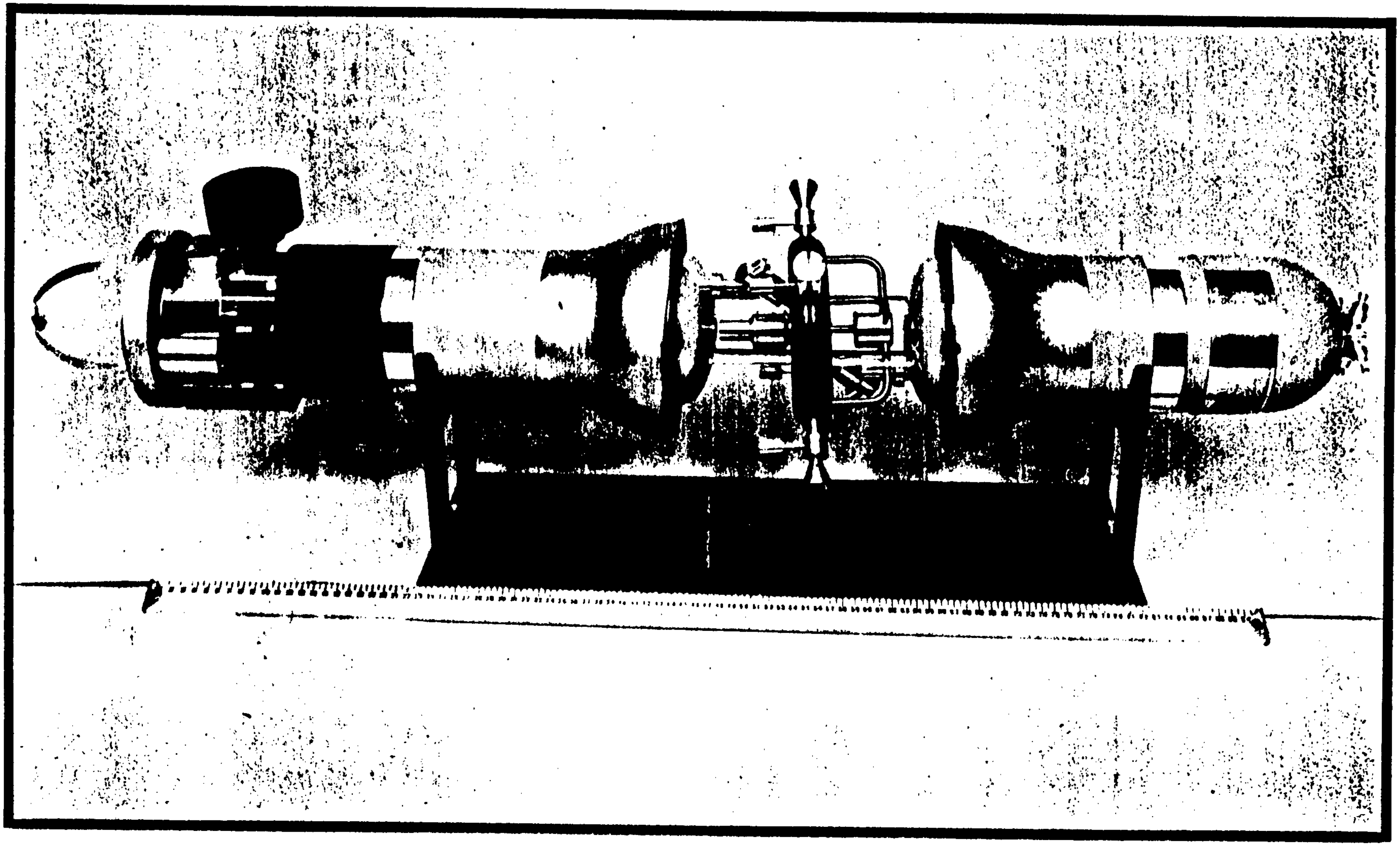
## Functions

- Destruction Of Boosters And PBVs
- Surveillance And Target Acquisition
- Laser 2-Way Communications

## Characteristics

- Interceptor Orbits In Protective Shell / Life Jacket
- Low Cost / Light Weight (88 Lbs)
- Highly Survivable Singlets
- Hit-To-Kill

# BRILLIANT PEBBLES (U)



89C-0106
7 Feb. 89

# FOLLOW-ON SYSTEMS

HEDI - High Endoatmospheric Defense Interceptor

SBL - Space Based Laser

NPB - Neutral Particle Beam

GBL - Ground Based Laser

# HIGH ENDOATMOSPHERIC DEFENSE INTERCEPTOR

## Functions

- Performs High Endoatmospheric Intercept (Terminal Defense Layer)
- Accepts Both Gound-Based And Midcourse Sensor Commit
- Acquires, Homes On, And Destroys An RV With A Non-Nuclear Kill Warhead
- Provides Defense Against Short Flight Time / Depressed Trajectories

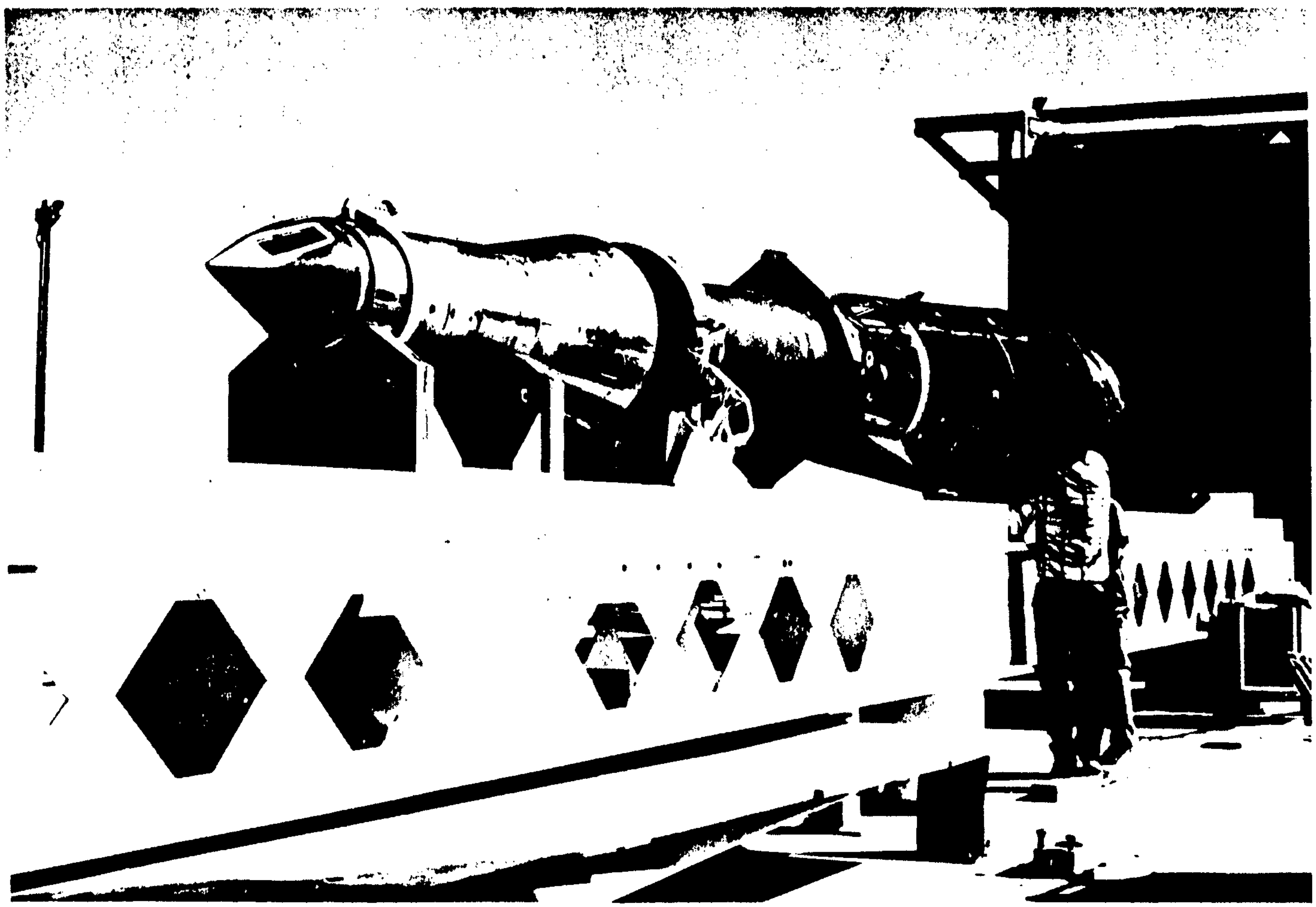
## Characteristics

- Kill Vehicle Weight <170 Kg (90 Lbs)
- Battlespace Altitude >70 Km (38 nm)
- IR Passive Seeker



jm-0569

# HEDI AT WHITE SANDS





89U-0375
8 Mar 89

# SPACE-BASED LASER

## Functions

- Intercept Boosters And PBVs
- Capability For Surveillance, Detection And Track Of Boosters, PBVs And RVs

## Characteristics

- Speed-of-light Delivery
- Rapid Retargeting
- Multispectral Sensors With Very Large Aperture Collectors
- Weight: 220,000 Lbs

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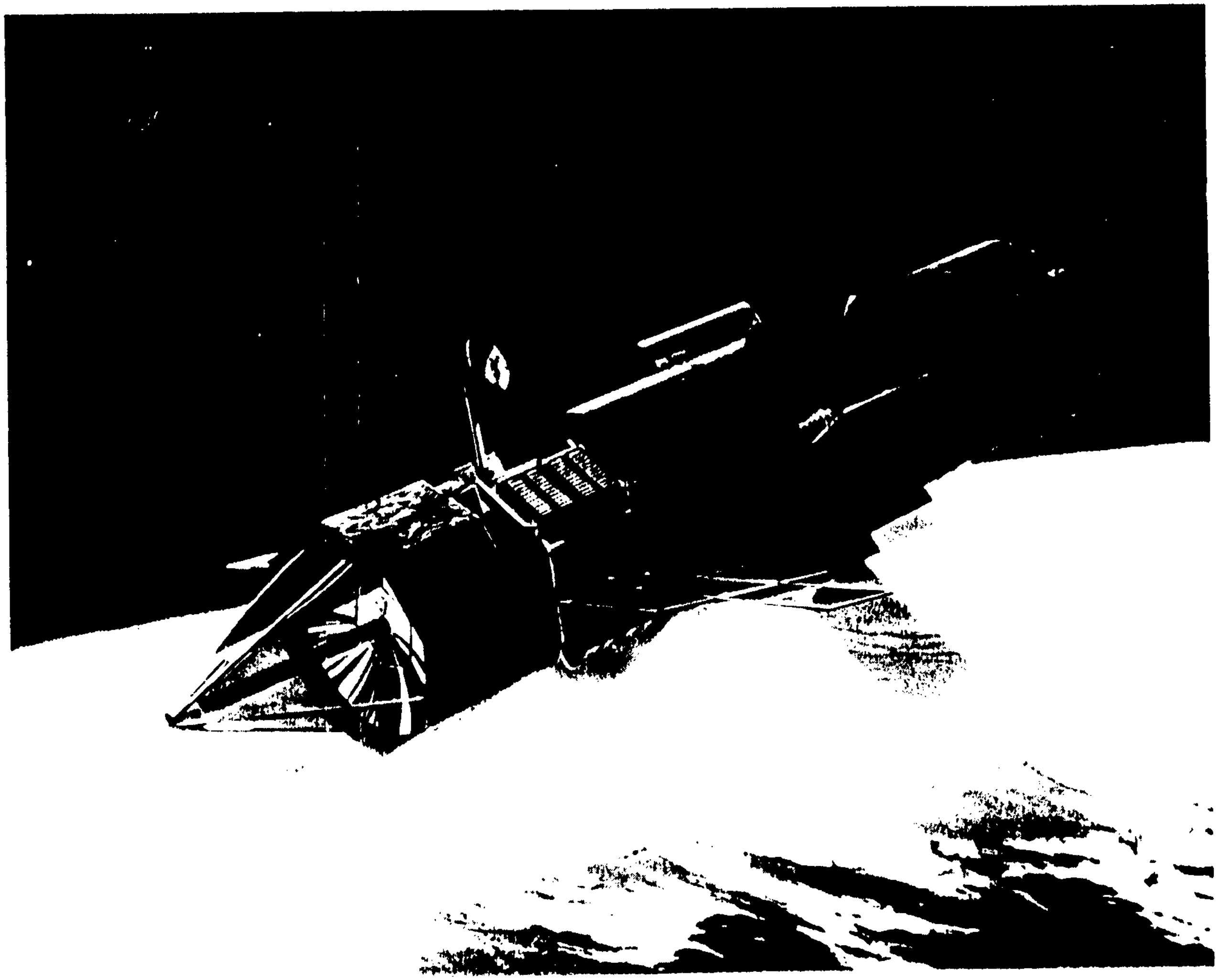
# ZENITH STAR



UNCLASSIFIED

VG 88 U 0689
14 Mar 88

# NEUTRAL PARTICLE BEAM

## Functions

- Destroy Boost And Post Boost Vehicles
- Discriminate RV's From Decoys

## Characteristics

- Rapid Retargeting / Multiple Shot Capability (17 / Sec)
- Operates In Hostile Nuclear Environment
- Kills Target By Indepth Penetration
- 116,000 Lbs Weight 120 Ft Length

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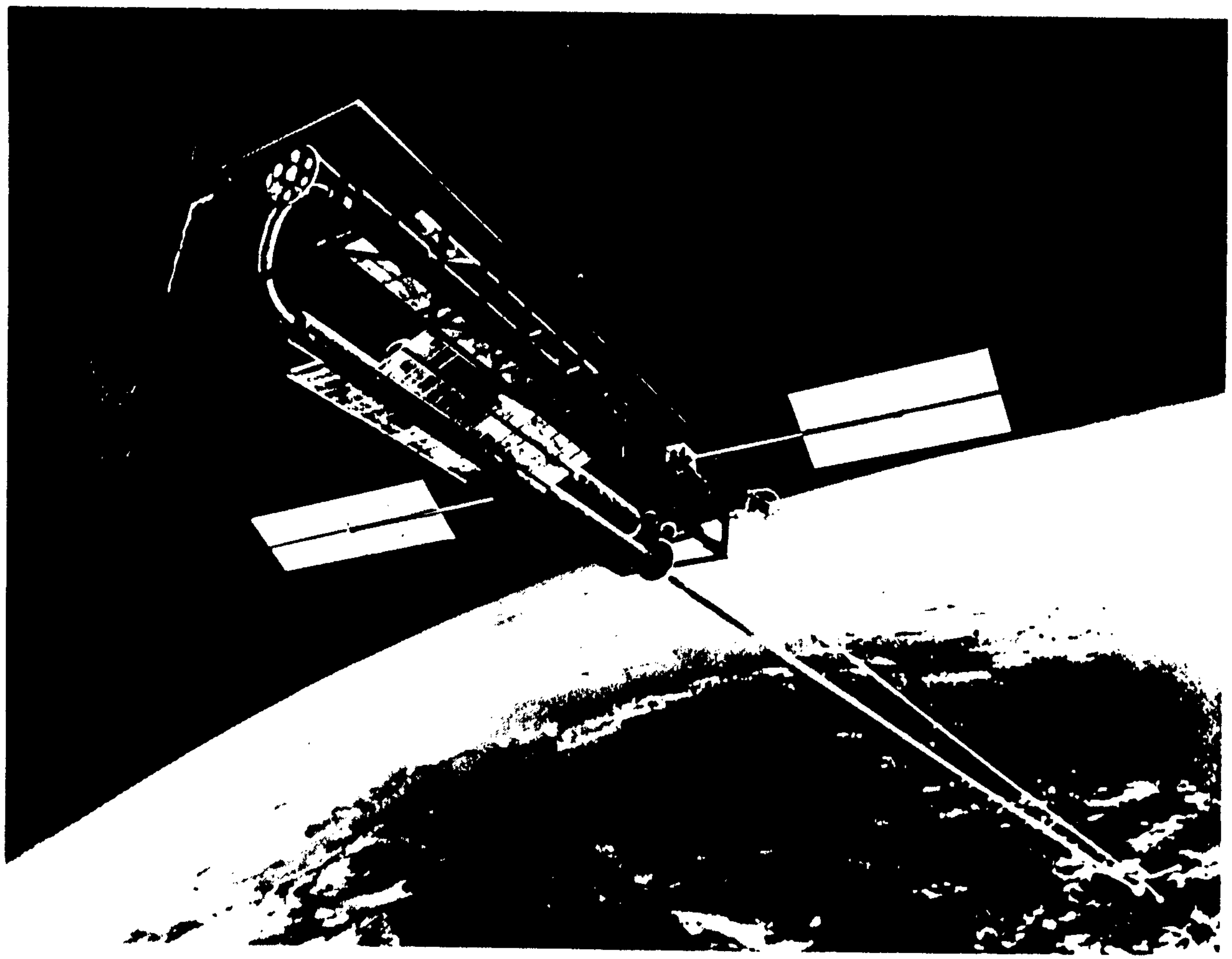
# NEUTRAL PARTICLE BEAM SPACE EXPERIMENT



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89U-0365
6 Mar 89

# GROUND-BASED LASER

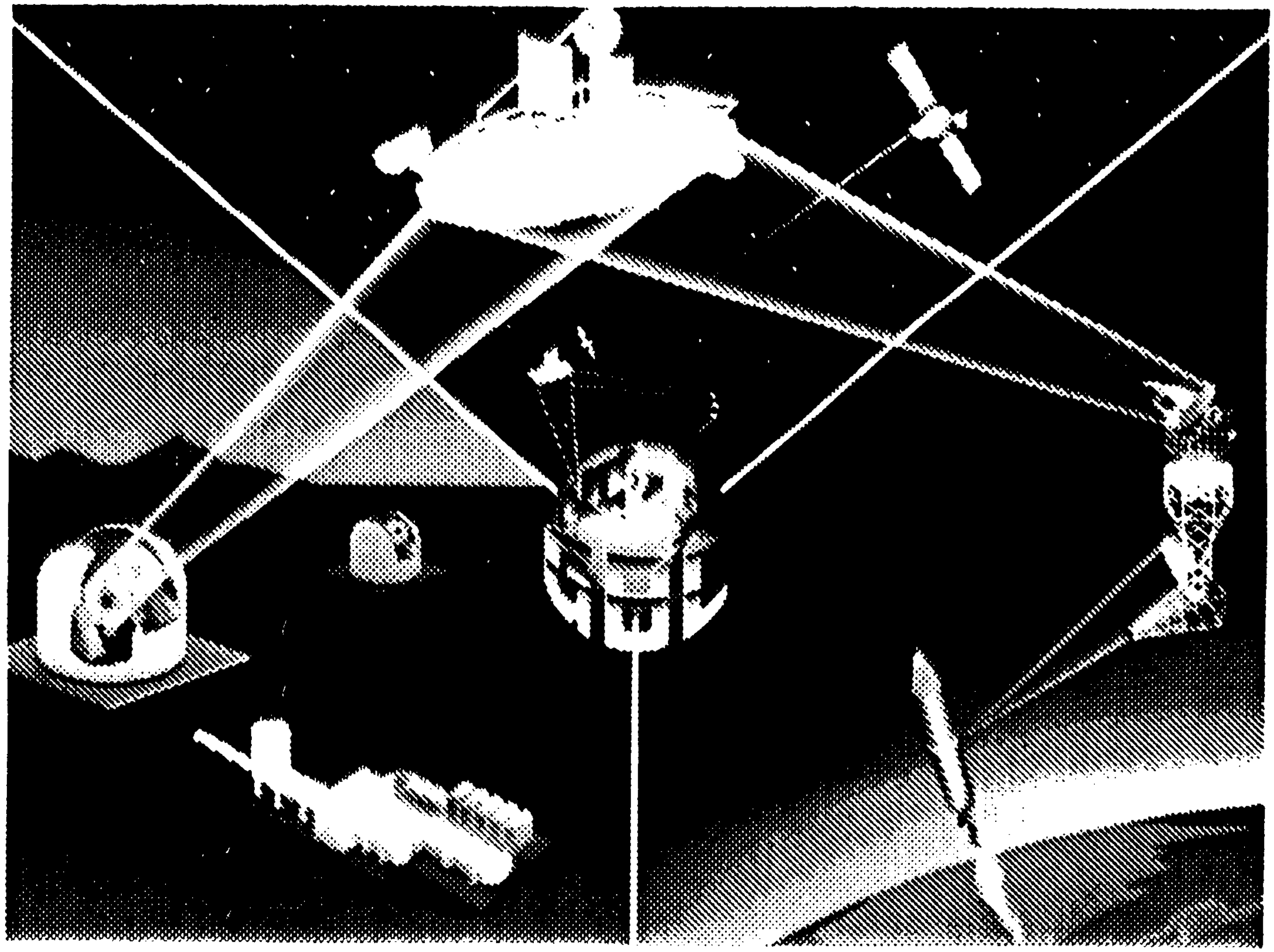
Functions

- Destroy Boosters And Post Boost Vehicles
- Discriminate Light Decoys From RV's
- Capability For Surveillance And Track

Characteristics

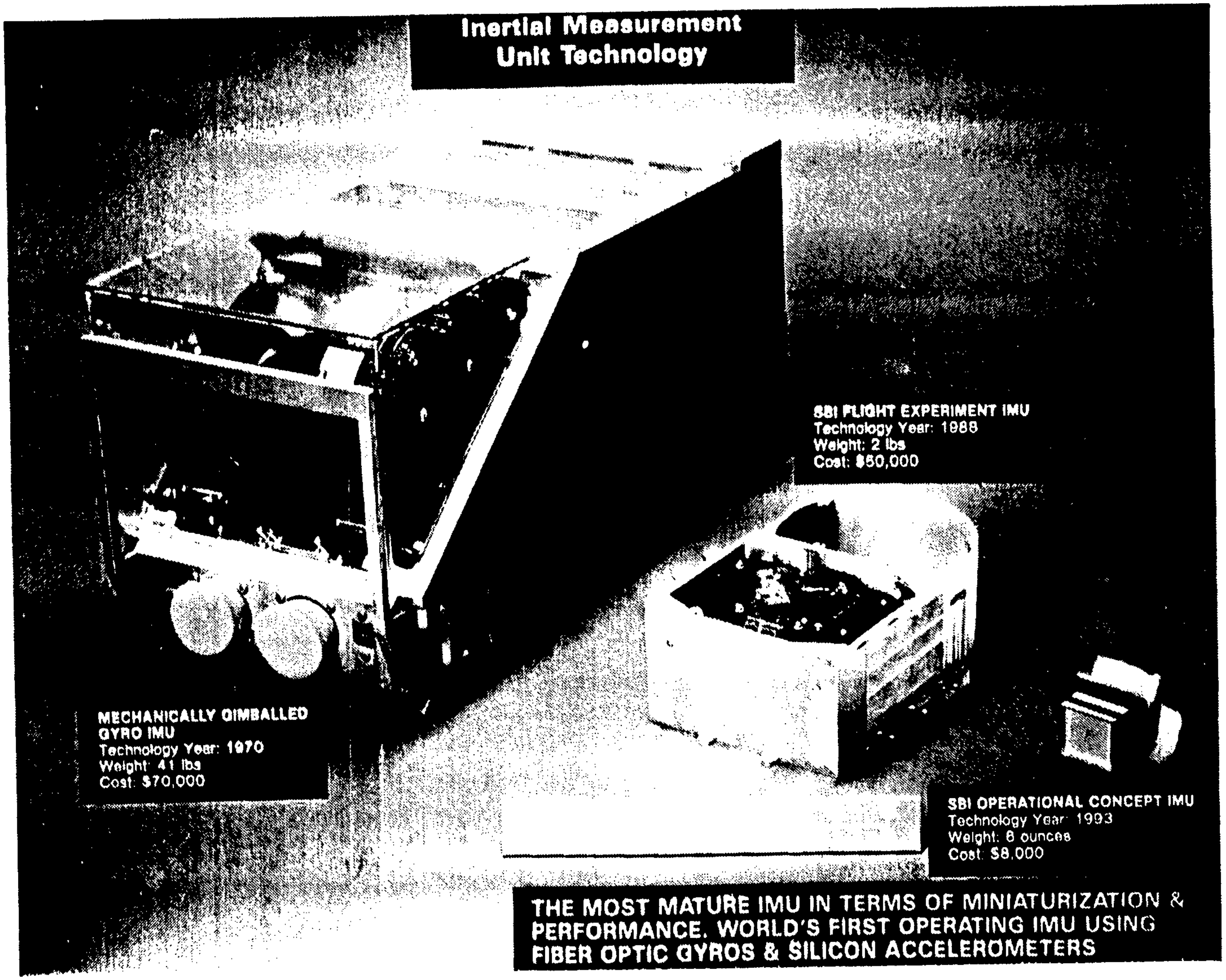
- Speed-of-light Delivery Into Atmosphere
- Rapid Retargeting
- Infinite Magazine
- Multispectral Sensors With Large Apertures
- Multiple Ground Sites To Avoid Clouds

# GROUND–BASED LASER



UNCLASSIFIED

# INERTIAL MEASUREMENT UNIT TECHNOLOGY

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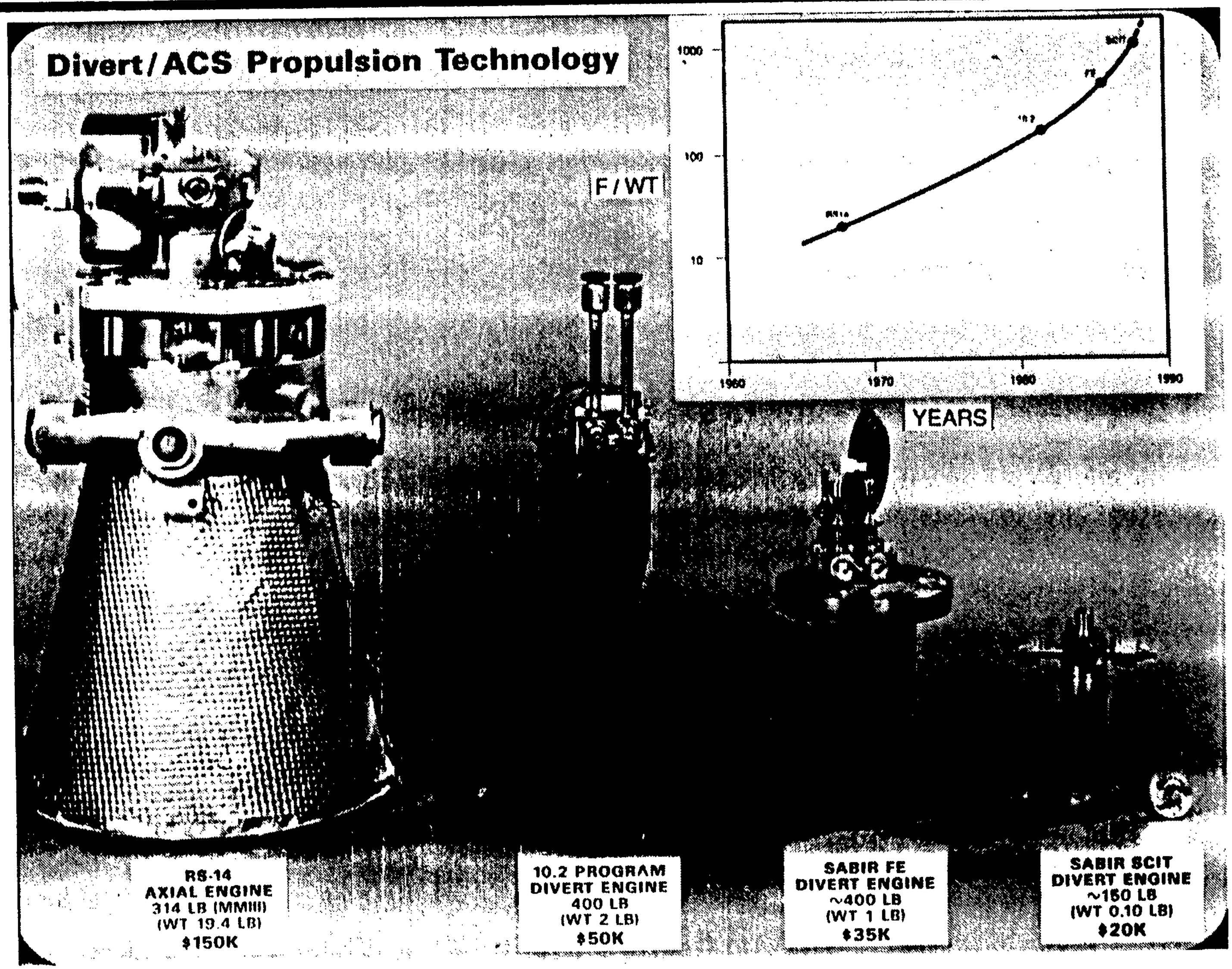
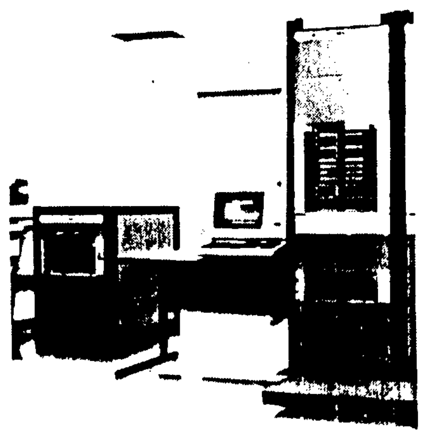
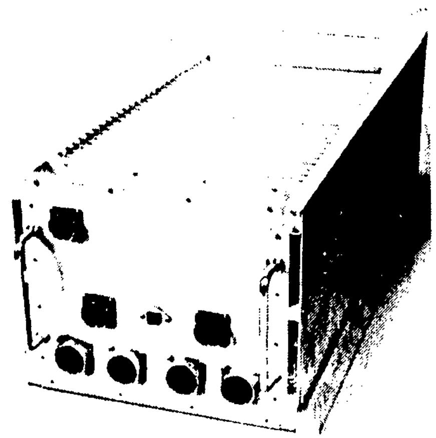
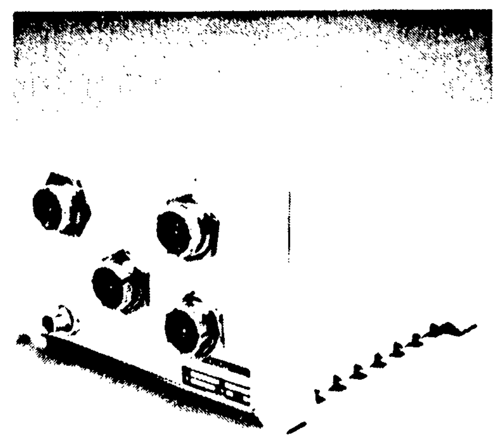
# DIVERT/ACS PROPULSION TECHNOLOGY




UNCLASSIFIED

880 3895
23 Dec 88

# SPACE PROCESSOR EVOLUTION

| | ADVANCED DISTRIBUTED ONBOARD PROCESSOR | AIRBORNE SURVEILLANCE TEST BED | GENERIC VHSIC SPACEBORNE COMPUTER |
|---|---|---|---|
| |  |  |  |
| SIZE | 4.5 $FT^3$ | 2.0 $FT^3$ | 0.25 $FT^3$ |
| WEIGHT | 130 LB | 130 LB | 12 LB |
| POWER | 1 kW | 1 kW | 80 W |
| ENVIRONMENT | LAB | FLIGHT | SPACE |
| THROUGHPUT | 3 MIPS | 3 MIPS | 15 MIPS |
| RADIATION HARDNESS | NON RAD-HARD | NON RAD-HARD | SDI |



VG 88-U-0292/1
10 Mar 89

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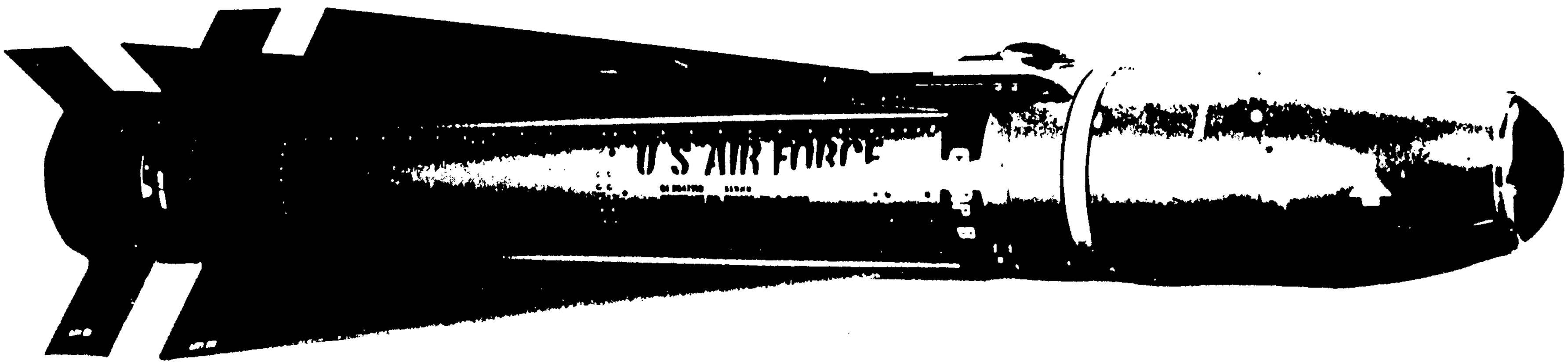
# TWO GENERATIONS OF INFRARED IMAGING TECHNOLOGY




**IR MAVERICK MISSILE**

| | |
|---|---|
| TOTAL WEIGHT | 675 LBS |
| VOLUME | 6.4 $FT^3$ |

**ELECTRONICS UNIT**

| | |
|---|---|
| WEIGHT | 100 LBS |
| VOLUME | 1.64 $FT^3$ |
| THROUGHPUT | 4.0 MIPS |

**LEAP PROJECTILE**

| | |
|---|---|
| TOTAL WEIGHT | 5.5 LBS |
| VOLUME | 0.14 $FT^3$ |

**ELECTRONICS UNIT**

| | |
|---|---|
| WEIGHT | 0.52 LBS |
| VOLUME | 0.025 $FT^3$ |
| THROUGHPUT | 4.2 MIPS |

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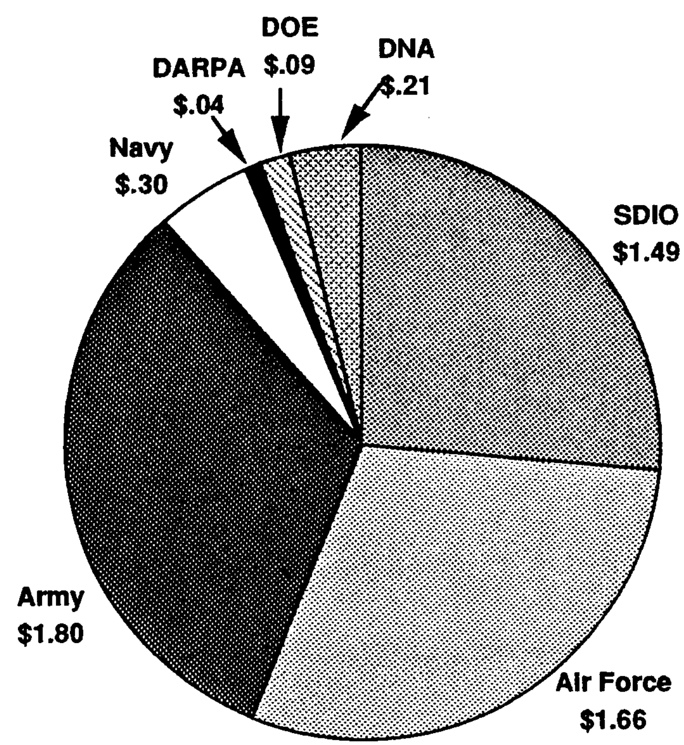
88U-3539
Nov 88

# FY 90-91 SDIO BUDGET

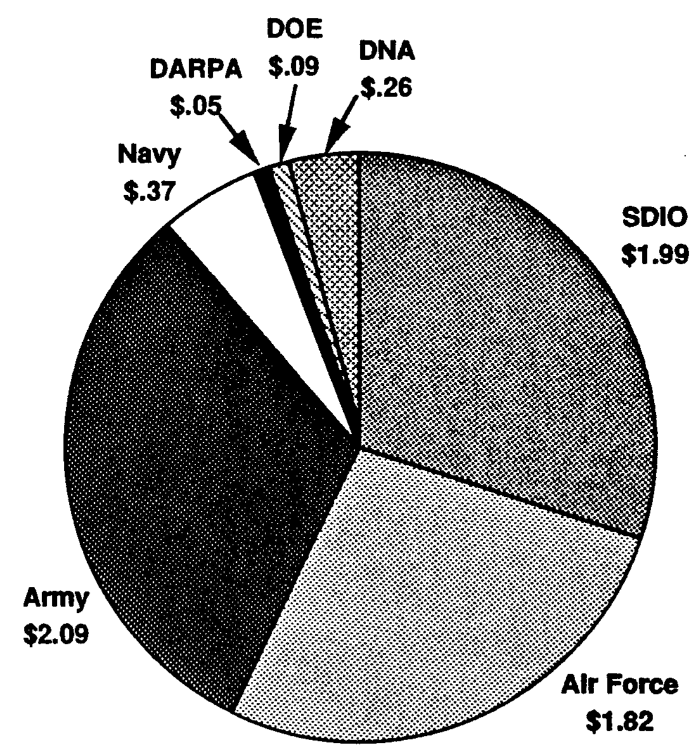
## Executing Agents ($ In Billions)

FY 90




Total: 5.59B

FY 91




Total: 6.67B

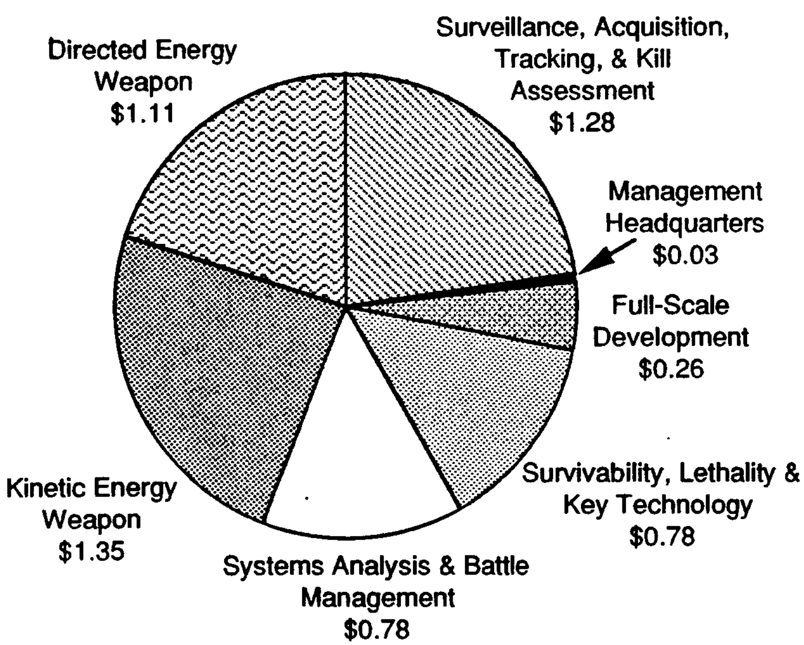


jm-0580

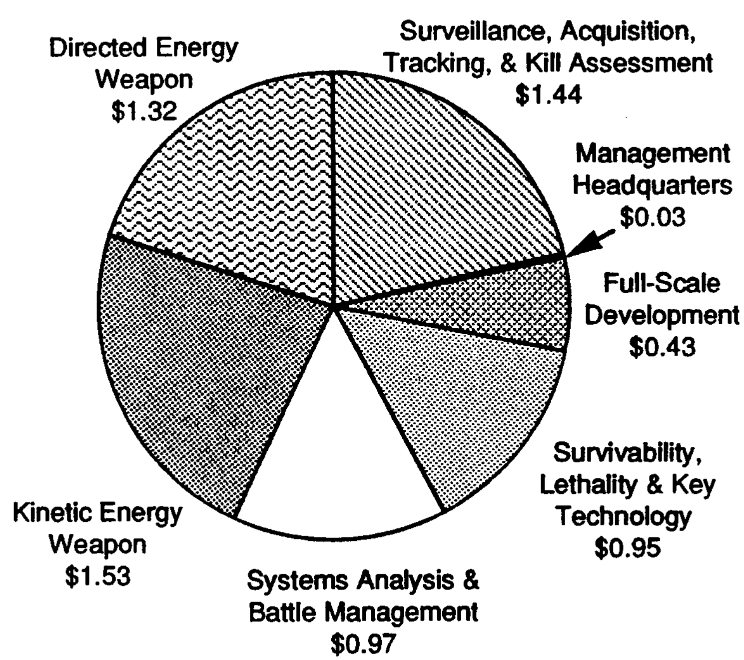
# FY 90 - 91 SDIO BUDGET

## Program Elements ($ In Billions)

### FY-90




### FY-91

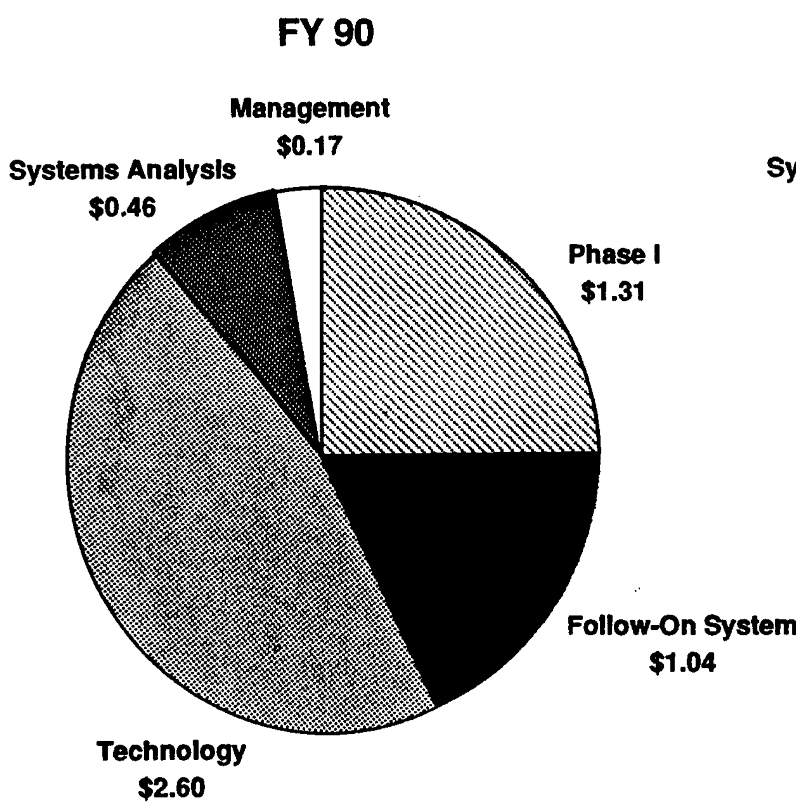


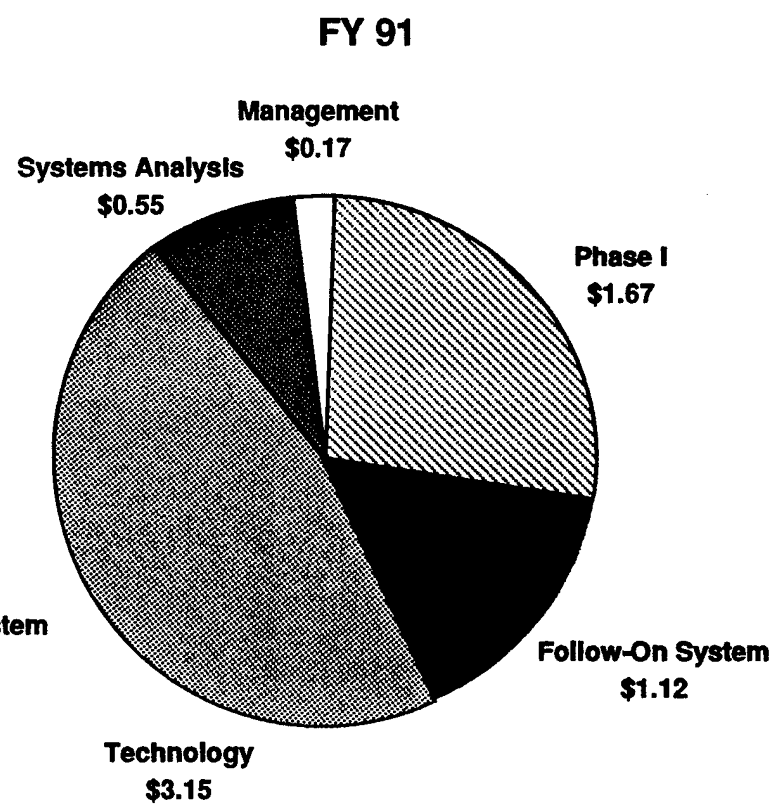



jm-0574

# FY 90-91 SDIO BUDGET

## Balanced Program ($ In Billions)






jm-0583

# SUMMARY

- Substantial Investment
- Significant Technology Advances Focused By System Analysis
- Current Budget Maintains Balanced Program